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Shamrock Timber Sale(s)

Final Environmental Impact Statement

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Stikine Area

Shamrock Timber Sale(s)

Final Environmental Impact Statement

Tongass National Forest - Stikine Area
USDA Forest Service
Alaska Region

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Abstract: This Final Environmental Impact Statement describes the effects of four "action" alternative approaches and one "no action" approach to harvesting timber in the Shamrock analysis area on Kupreanof Island.

Summary

Summary

Introduction

One or more short-term timber sales are proposed on Kupreanof Island. These sales are allowed by the Forest Plan (USDA Forest Service, 1979a) to maintain a supply of timber for the logging community in Southeast Alaska. Most of the Shamrock analysis area on Kupreanof Island is identified in the Forest Plan as LUD IV, managed to provide for "intensive resource use and development where emphasis is primarily on commodity or market resources." Four action alternatives and a no action alternative are considered in this EIS. Ecosystem management and alternative harvest concepts are introduced into this analysis to varying degrees under all alternatives.

Issues

The alternatives were developed to address 11 issues identified through public scoping, state and other Federal agency involvement, and as management concerns by the interdisciplinary team (ID Team) that conducted the analysis for this EIS:

- Timber harvest economics,
- Stream habitat conditions for fish,
- Wildlife habitat,
- Wild and Scenic rivers,
- Recreation,
- Visual quality,
- Access to new areas,
- Subsistence,
- Wetlands and watershed,
- Biodiversity and old-growth forests, and
- Cultural resources.

Alternatives Considered

Alternative 1

The No Action Alternative would maintain existing conditions in the Shamrock area, resulting in only natural changes. The area would remain largely undeveloped.

Alternative 2

This alternative would harvest the highest volume of timber over a broad portion of the Shamrock area and develop the planned transportation system between the north and south portions of Kupreanof Island. Approximately 54.8 million board feet (MMBF) of net sawlog volume and 2,702 acres would be harvested, and 42.3 miles of specified road[1] would be constructed. Some harvesting is proposed in tentatively eligible Wild and Scenic River corridors.

Alternative 3

This alternative would emphasize biodiversity by minimizing fragmentation of old-growth forest and confining harvest activities to fewer watersheds. Approximately 22.3 MMBF of net sawlog volume and 1,176 acres would be harvested, and 24.6 miles of specified roads would be constructed.

Alternative 4

This alternative would harvest a moderate amount of timber and construct a major arterial road through the Shamrock area, providing a link between the north and south portions of Kupreanof Island. Approximately 33.9 MMBF of net sawlog volume and 1,766 acres would be harvested, and 33.8 miles of specified road would be constructed.

Alternative 5

This alternative was designed to emphasize timber sale economics by harvesting a relatively high volume of timber but minimizing construction of new roads. Approximately 39.2 MMBF of net sawlog volume and 1,948 acres would be harvested, and 33.8 miles of specified roads would be constructed.

Helicopter Logging

Only Alternative 2 plans any helicopter logging. There would be 342 acres within three units harvested by helicopter under this alternative. These helicopter units were designed to make timber available in an area that was not cost effective to access by road.

Consequences

Each alternative provides a different mix of resource outputs that emphasizes different resource values.

Timber Harvest Economics

All action alternatives show a negative estimated net value, with Alternative 2 having the least negative net value, followed in order by Alternatives 5, 4, and 3. These negative net values reflect the initial capital investment in specified road construction.

Stream Habitat Conditions for Fish

All alternatives would pose some risk to fisheries. However, by following Best Management Practices and Aquatic Management Habitat Unit guidelines, effects on stream habitat and fisheries are not expected to be substantial under any of the alternatives. Using measures of risk to fish habitat, such as total length of roads and harvest area within a watershed, number of stream crossings, and length of unbuffered and buffered streams, Alternative 3 was judged to have the least potential and Alternative 2 the greatest potential for impact to fisheries, while Alternatives 4 and 5 would be intermediate.

Wildlife Habitat

Because all alternatives result in the conversion of old-growth forest to second-growth, there would be loss of habitat for wildlife species dependent on old-growth. Reductions in old-growth habitat would be directly proportional to the area harvested, but reductions would be less than 7.5 percent of any habitat suitability category for five selected Management Indicator Species (MIS). Since all harvest areas are a considerable distance from marine shoreline, there would be no harvest within the 1000-foot estuary fringe zone or within the 500-foot beach fringe zone.

Wild and Scenic Rivers

Alternative 2 proposes some harvest within eligible Wild and Scenic River corridors (Castle River and Tunehean Creek). Recommendation or non-recommendation of these streams to Congress as suitable for Wild and Scenic River designation will be part of the Record of Decision for the Revised Tongass National Forest Plan. Harvest within the corridor of a wild and scenic study river would be deferred until this decision.

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[1] The location and construction standards of these roads are specified by the Forest Service. Specified roads are sometimes referred to as permanent or system roads.

Recreation

Implementation of the action alternatives would result in varying degrees of change in recreational opportunities within the Shamrock area. Primitive recreational opportunities would decline, while semi-primitive non-motorized and roaded modified recreational opportunities would increase. Alternative 3 would result in the least change in recreational opportunity among the four action alternatives.

Visual Quality

The harvest of timber and the construction of roads inevitably results in changes to seen areas. Proposed harvest units are primarily visible from Duncan Canal and the Petersburg-Tebenkof small plane route, which traverses the southern portion of the Shamrock area. From Duncan Canal, only harvest units in Alternative 2 and 5 are in seen areas. From the Petersburg-Tebenkof small plane route, Alternative 2 would result in the greatest amount of harvested acres in seen areas.

Access to New Areas

All of the action alternatives would result in increased access into the Shamrock area. The construction of specified roads would provide vehicle access to an area that is now largely unroaded. Alternatives 2 and 4 would result in the greatest change in access, with construction of an arterial road connecting existing roads at the northern end to the southern boundary of the Shamrock area.

Subsistence

As a result of all action alternatives, subsistence use of the Shamrock area would potentially be affected by increased access and effects on wildlife habitat, particularly that of Sitka black-tailed deer. Increased access would lead to increased opportunities for subsistence and other users, which in turn would result in increased exploitation of wildlife populations and other resources. Carrying capacity of the area for Sitka black-tailed deer is not expected to decline appreciably as a result of any of the action alternatives.

Wetlands and Watersheds

Some forested wetlands would occur within harvest units under all action alternatives, and specified roads would cross wetland areas. Impacts to watersheds would occur due to erosional effects of harvesting and road construction, however implementation of Best Management Practices should substantially reduce these impacts.

Biodiversity and Old-Growth Forests

All action alternatives would result in loss and fragmentation of old-growth forest. Because the proposed harvested areas would be the first in the Shamrock area, the effect of these changes on biodiversity are not expected to be substantial. Impacts to biodiversity from the Shamrock harvest are best addressed in the context of cumulative effects on an island wide basis.

Cultural Resources

Since there were no cultural resource sites identified in the Shamrock area and predictive modeling indicates there is a low probability of sites occurring in harvest areas, there is little likelihood that cultural resources would be impacted as a result of any action alternative.

Mitigation of Consequences

If an action alternative is selected, the following mitigative measures would be required for implementing timber harvest in the Shamrock area, pending their incorporation into the Record of Decision (ROD) by the Stikine Area Forest Supervisor.

- Pursuant to the Tongass Timber Reform Act (TTRA) of 1990, commercial timber harvesting would be prohibited within a buffer zone no less than one hundred feet in width on each side of all Class I streams and those Class II

streams which flow directly into a Class I stream. To protect downstream water quality, other Class II and all Class III streams would, where appropriate, receive protection through a combination of one or more of the following: directional felling of trees, partial suspension of logs, split-yarding, and removal of logging debris from stream channels.

- Full bench construction and end hauling of excavated material would be required on designated areas for maintaining soil stability and to prevent sedimentation from entering streams.

- Group selection, green tree retention, and snag retention would be implemented where feasible to help maintain wildlife habitat, structural diversity, biodiversity, and visual quality.

- After use is completed, temporary roads would be closed, water bars added at appropriate places, and drainage structures removed.

- Timing restrictions on in-stream road construction work would be implemented when and where appropriate during critical periods to protect fishery resources.

- Stream crossings of Class I and II streams would be constructed to allow continued fish passage.

- Partial suspension during log yarding would be required in designated harvest units to reduce soil disturbance, thus maintaining soil productivity and minimizing soil transport to streams.

- Bridges would be installed at designated stream crossings to minimize the amount of sediment entering stream channels.

- All discovered cultural sites would be protected. If sites are discovered once the sale is in operation, protective measures will be taken under the Timber Sale Contract.

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Purpose and Need

Chapter 1

Purpose and Need

Introduction

Proposed Action

The Stikine Area of the Tongass National Forest proposes to offer up to 55 million board feet (MMBF) of commercial timber within the Shamrock area on Kupreanof Island including construction of an associated road system (Figure 1-1). The timber would be sold in one or more timber sales beginning in 1996, and would be transported to salt water over the Little Hamilton log transfer facility.

Purpose and Need for Proposed Action

The purpose of the proposed timber harvest(s) is to meet the goals and objectives for Stikine area of the Tongass National Forest and to provide for long-term transportation needs for National Forest visitors and administration. The economies of communities in Southeast Alaska are largely dependent on the Tongass National Forest to provide natural resources for uses such as fishing, timber harvesting, recreation, tourism, mining, and subsistence. The Forest Plan Revision and several studies used in this analysis conclude that market demand for timber will remain strong during the 1990s, with National Forest timber expected to account for at least two-thirds of the total harvest. The proposed sale or sales would provide 22-55 MMBF of the government's commitment to the timber industry.

Management Direction

The Forest Plan is presently undergoing revision. The proposed Forest Plan Revision (USDA Forest Service, 1991d) subdivides the four previous land use designations (LUDs) into 23 LUDs. The proposed Forest Plan Revision would change portions of the Shamrock area that are currently LUD IV (timber production) to semi-primitive recreation (Figure 1-2). For the analysis conducted for this EIS, consideration has been given to both the current Forest Plan and the proposed Forest Plan Revision so that decisions will be ultimately consistent with both the present guidelines and anticipated land management direction.

Desired Future Condition

Most of the Shamrock area, as well as most of Kupreanof Island is designated by the Forest Plan for intensive development to maintain and promote industrial wood production and would continue as such under the proposed Forest Plan Revision. However, some lands near Duncan Canal and other waterways are now proposed for semi-primitive recreation to be maintained in natural appearing settings. Timber harvest in these areas is restricted to salvage operations. Outside the analysis area, timber harvest is prohibited in the Petersburg Creek-Duncan Salt Chuck Wilderness (MA S15), and severely restricted in the primitive recreation areas of Rocky Pass (MA S12).

Planning for a timber harvest in VCUs 429, 436, and 438, which represent the Shamrock area, was scheduled in the 1985-86 Amendments to the Forest Plan, with the sale targeted for 1995. The Forest Plan Revision also includes an additional

timber harvest (Clover Sale) in the Shamrock area for the ten-year timber harvest schedule for 1995 through 2004, and is scheduled for 1996.

This EIS is tiered to the Tongass Land Management Plan EIS and the Alaska Regional Guide (1983). Tiering means that the EIS will follow guidance provided in those planning documents. Relevant portions of those documents are incorporated by reference into this EIS.

Decisions To Be Made

The management decisions to be made by the Stikine Area Forest Supervisor are whether and how to make timber available in the Shamrock analysis area to meet market demands and Forest Plan Goals for Southeast Alaska. Based on the environmental analysis of consequences in this EIS, the following decisions will be documented in the Record of Decision:

- whether or not to harvest timber in the Shamrock area at this time,
- the amount of timber volume to make available for harvest,
- the location and design of timber harvest units,
- the location and design of associated mainline and local road corridors, and
- mitigation measures associated with each alternative.

Organization of This EIS

Chapter 1 provides the purpose and need for which the Forest Service is proposing action, the public issues surrounding the action, and other introductory information. Chapter 2, Alternatives, presents and compares the alternatives and includes summary information on their environmental impacts, implementation, and mitigation. Chapter 3, Affected Environment, describes the environment which may be affected by the alternatives according to the issues described in Chapter 1. Chapter 4, Environmental Consequences, predicts environmental changes likely to occur with implementation of the alternatives. These changes include both direct and indirect impacts of the alternatives for each resource issue. Potential cumulative impacts of reasonably foreseeable or similar actions are also disclosed. Finally, supportive information is included in the appendix of the EIS.

Location

The Shamrock area is located on Kupreanof Island, 15 air miles southwest of Petersburg, in Southeast Alaska, and is between Duncan Canal and Rocky Pass (Figures 1-1, 1-3). The area encompasses 108,000 acres within Townships 59, 50, and 61 South, and Ranges 76, 77, and 78 East (Copper River Meridian). Elevations range from sea level to 2,500 ft. Although outlying coastal areas can be reached by float plane or boat, existing access is almost exclusively by helicopter or on foot. Two lakes located within the area can be used by float planes.

The analysis area comprises Value Comparison Units (VCUs) 429, 436, and 438 as described in the Forest Plan (Figure 1-2). VCUs are distinct geographic areas, each of which generally encompasses a drainage basin containing one or more large stream systems. Adjacent VCUs having common management direction constitute Management Areas (MAs). VCU 429 is part of MA S11, whereas VCUs 436 and 438 are included in MA S13. The most concise descriptions of management direction and scheduled activities for these MAs can be found in the 1985-86 Amendments to the

Figure 1-1
Project Location in Relation to Tongass National Forest

View of Shamrock area, with subalpine meadow in foreground

Forest Plan. More current information and direction is provided in the Forest Plan Revision.

Background

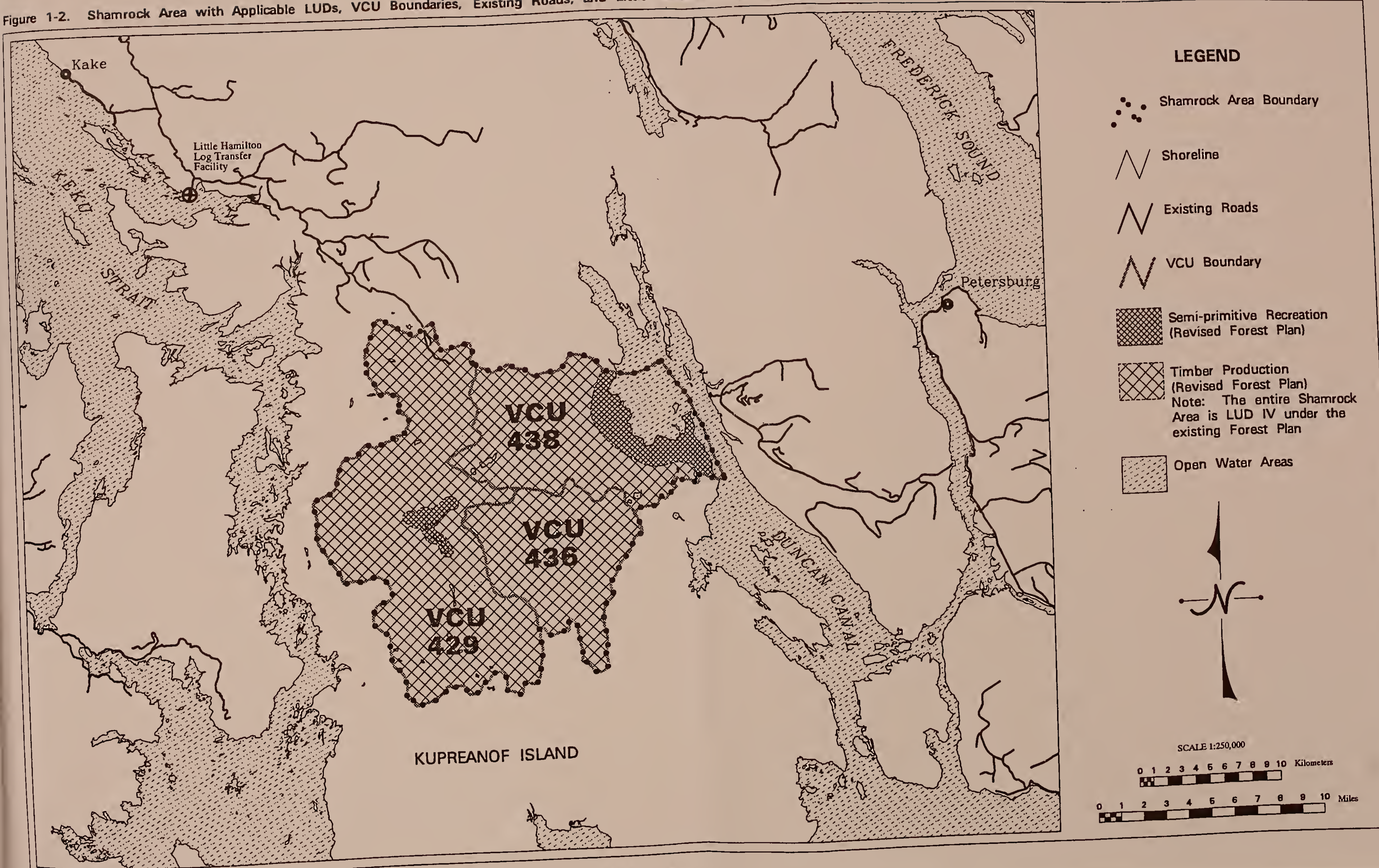
Because most of Kupreanof Island has been and is proposed to be managed for timber production, several timber harvests have occurred or are being planned. All were originally offered as independent timber harvests. Some never sold; two were incorporated as substitute volume for long-term contracts. Timber harvests for which harvest is complete include:

- Hamilton Creek South, completed in 1981,
- Portage Twelve-Mile, completed in 1984,
- Todahl, completed in 1991,
- Toncan, completed in 1992,
- Missionary, completed in 1992,
- Tonka Mountain, completed in 1992, and
- White Alice Salvage, completed in 1993.
- Combination (previous units from Bohemia and Pipeline sales), sold in 1989, completed in 1994; and
- Portage Bay Salvage, sold in 1992, completed in 1994.

Timber harvests which have been sold but harvest has not been completed include:

- North Irish Creek, sold in 1980, sale terminated in 1992, remaining volume will be reoffered in the future;

Figure 1-2. Shamrock Area with Applicable LUDs, VCU Boundaries, Existing Roads, and Little Hamilton Log Transfer Facility




SHAMROCK
AREA
Kake
Grave I
Burnt I
Hamilton I
Eva I
Hamilton
L Hamilton I
Hound
Island
Hare I
Clark I
Pup I
Pt Camden
Entrance I
Berry I
Beacon I
Horseshoe I
Mc Naughton Pt
High
Island
Cam I
Summit
Eagle I
Monte
Carlo I
Skiff I
Meadow I
Kupreanof
Mountain
Portage
Mountain
Duncan Pk
Goose Pt
Indian Pt
Rookery I
High Castle I
Cloverleaf I
Big Castle I
Castle
Islands
Grief I
Pearl
Fair I
Emily I
Woewodski
Island
Butterworth
Island
Kah Sheets
Lung I
Battery
Islets
Keene I
Woody I
Bush Top I
North Pt
Petersburg
Mountain
Petersburg
Kupreanof
Sandy Beach
Frederick
Pt
McDonald
Sukoi
Islets
Del Monte
Peak
Sheridan Pk
Scott Pk
Cape Strait
Wood Pt
Patterson
Pks
Church
Peak
House Pk
Dupont Pk
Rodgers Pk
Horn Mtn
Thunder
Mtn
Indian Pt
Camp I
Coney I
Grassy I
Pocket
Hidden I
Little Dry
Summit I
Manzanita
Peak
Favor Pk
Sam
Pk
Wilson
Is
Rynda I
Sokolof
Island
Greys I
Two Tree I
Station
Island
Pt Howe
Pt Alexander
Woodpecker
Cove
F R E D E R I C K
S O U N D
D U N C A N
C A N A L
K U P R E A N O F
T O N G A S S
I S L A N D
K E K U
S T R A I T
Wrangell
Narrows
Sumner
Mountains
Dry
Strait
Dry Island
Lindenberg
Peninsula
Mitkof
Island

Other pending timber harvests include:

- Bohemia Mountain, scheduled for offer in 1995; and
- South Lindenberg, scheduled for offer in 1997.

Analysis Process

The Tongass National Forest published a Notice of Intent to contract the Shamrock timber harvest analysis and prepare the EIS in the Federal Register on December 23, 1991 (Vol. 56, No. 246, pp. 66428-66429). The required services were contracted in March 1992, and an interdisciplinary team (IDT) of resource specialists was formed to conduct the analysis and prepare the EIS.

Preliminary issue identification began in April 1992 through personal contacts with community and tribal leaders in the vicinity, a review of issues raised in other recent timber harvests, and management concerns raised by resource specialists. A public participation plan was also prepared. Public scoping of issues formally began in early May 1992 with the mailing of a scoping notice and scoping statement to more than 200 public participants on a mailing list provided by the Forest Service. Scoping announcements were simultaneously posted in a variety of public places in the vicinity and published by area news media. Responses from the public were then used to identify additional issues and refine those already under consideration.

Field studies were then conducted to collect specific information relative to issues and to verify resource information contained in the Tongass National Forest geographic information system (GIS). Examples of resource values displayed by GIS include sensitive stream zones, important wildlife habitat, timber and soil inventories, and location of proposed harvest zones. Field studies utilized unit and road design cards for all action alternatives to document the location of proposed harvest units and roads. Resource specialists listed specific concerns on the cards, and also recommended how those concerns should be addressed or mitigated (Appendix A). Information from field studies and GIS were then used to address the issues and analyze the environmental effects of each alternative. The entire analysis was used by the Forest Service to select a preferred alternative for publication in both the Draft and Final EIS. The Draft EIS (DEIS) was distributed for public review and comment in July 1993 and the comment period on the DEIS continued until November 22, 1993.

A Supplement to the DEIS was published in October 1994 to allow public review of and comment on several modifications to the four action alternatives for the Shamrock Timber Sale that were made subsequent to the publication of the DEIS. These modifications included (1) the incorporation of one unit and road segment from the North Irish Timber Sale Reoffer, (2) minor changes in the proposed Shamrock road system, (3) designation of retention areas, (4) effects on species listed in the January 1994 Alaska Region Sensitive Species List, and (5) changes in the ANILCA 810 findings for Sitka black-tailed deer. Comments to both the DEIS and the DEIS Supplement were responded to by the Forest Service and appropriate changes have been integrated into this FEIS.

Inventories, resource specialist reports, and GIS information are part of the Shamrock area planning record. Also included in the planning record are results of public scoping and the unit and road design cards. The planning record will be available for public inspection at the Stikine Area Forest Supervisor's Office in Petersburg, Alaska.

Issues

The issues described below were developed from concerns raised by resource specialists, other Forest Service staff, and the public during the scoping process. These issues were used to direct the formulation and evaluation of the alternatives. The description of issues is organized according to the resource areas covered in Chapters 3 and 4 to allow tracking of each issue through the EIS. For each resource, scoping comments are summarized followed by a statement of the pertinent issue and the measures by which that issue is addressed in the analysis.

1. Transportation

Comments: The persons commenting differed in their perspectives over whether increased access would be a benefit or a disadvantage. Undesirable aspects of improved access to some areas include potential over-use of resources and reduced aesthetics associated with recreation and subsistence. Conversely, desirable aspects include the ability to manage remaining stands of commercial timber, additional recreational or subsistence access, and compatibility with long range transportation plans.

Issue: What effect will road construction and subsequent road maintenance following harvest have on access to and within the Shamrock area?

Measurement: For each alternative, miles of road constructed and miles of road remaining open following the completion of sale activities were determined. Impact of roads on access are discussed in the Subsistence and Recreation sections and impacts of road construction are addressed in sections on fish, watershed, and soils.

2. Vegetation

Timber Resources

Comments: A major concern of foresters is the long-term health and productivity of the forest. From a timber resource perspective, the conversion of overmature old-growth stands to second-growth stands more productive for wood fiber is a positive benefit of harvesting. However, loss of forest productivity occurs if mass-wasting results from harvesting activity.

Issue: How will long-term forest health and productivity be affected by harvesting and the specific harvest treatments in the Shamrock area?

Measurement: The effects of harvest treatments were assessed at the unit level. Each unit in the unit pool was evaluated for the appropriate silvicultural treatment and for potential effects of mass-wasting. For each unit, the silvicultural prescription, logging method, and unit boundaries are the result of this evaluation.

Threatened, Endangered, and Sensitive (TES) Plants; Wetlands

Comments: Federally listed TES plants are protected by law from impacts due to harvesting on Forest Service lands. Federal policy also requires that harvest and road impacts to wetlands be minimized. In the scoping process, representatives of the timber industry requested that current standards and guidelines be followed regarding wetland designation of the analysis area. One individual was also concerned about the cumulative effects of wetland disturbance from harvesting.

Issue: Will harvesting and road construction result in adverse impact to any populations of TES plants? What are the expected losses of wetland area and functional value under each harvest alternative?

Measurement: Potentially affected TES plants were identified using The Alaska Region Sensitive Species List and by consultation with the Alaska Natural Heritage Program (ANHP) and the U.S. Fish and Wildlife Service (USFWS). Surveys were conducted for any populations of Federally listed TES plant species potentially occurring in harvest units or roaded areas. Wetlands were delineated using current standards and guidelines and evaluated for impacts to functional value.

3. Wildlife

Comments: Agencies, industry, and an environmental organization provided comments regarding wildlife. The USFWS was concerned about overall wildlife impacts, as well as effects on rare and sensitive species. The agency requested that wildlife surveys be conducted, and that the harvest is in compliance with interagency agreements. The Alaska Department of Fish and Game (ADF&G) also requested that all wildlife species are considered when evaluating effects of timber harvest. They recommended the use of habitat capability models to determine effects on wildlife and that monitoring programs be developed. ADF&G stated that pre-commercial thinning is not considered a mitigation measure for wildlife, and that the development of roads will adversely impact subsistence wildlife. Ketchikan Pulp Corporation (KPC) stated that specific attention should not be given to the northern goshawk or the marbled murrelet because they believe that the goshawk is common and not enough information is known about the marbled murrelet. The Narrows Conservation Coalition (NCC) requested that adequate deer habitat is maintained and that timber harvest not occur within an 1,000 foot buffer on estuarine areas. Comments from individuals include their concern on harvesting impacts on deer, marbled murrelets and other wildlife.

Issue: What effects will timber harvest and related activities have on wildlife habitat?

Measurement: Indicators related to this issue are the percentage of habitat and critical habitat affected, computer-projected population numbers and trends, and size or location of harvest units relative to preferred habitats. Population trends were modelled for Sitka black-tailed deer, pine marten, black bear, river otter, and bald eagles. Distributions of the northern goshawk and marbled murrelet are also described.

4. Fish

Comments: The ADF&G, NCC, and individuals provided several comments regarding fisheries resources in the Shamrock area. The ADF&G was concerned about the impact on fisheries resources. They recommended that stream crossings are minimized, there is no construction in streams from August 1 to July 18, and that bridges are constructed over road crossings of high gradient streams. The NCC was concerned about the cutthroat, coho and steelhead fishery and the impacts of harvesting on increased river temperatures. Individual comments included water quality impacts to Duncan Canal, loss of salmonid populations, and fish passage at culverts.

Issue: What effects will timber harvest and road construction have on habitats used by trout and salmon?

Measurement: Quantitative measures of responsiveness to fisheries include the number of road crossings, miles of road adjacent to streams, miles of Class I and

Class II streams requiring buffers along harvest units, and percentage(s) of each watershed selected for harvest.

5. Biodiversity

Comments: Many general comments concerning biodiversity and old growth were received from agencies and individuals. The ADF&G stated that the most recent recommendations from the Interagency Viable Population Committee should be presented, discussed, and incorporated into the EIS. This committee is concerned about the impacts on fragmentation, patch size, and loss of old growth. Considerable comment was received from individuals concerning the forest ecosystem that included the health of the temperate rain forest and cumulative effects of all timber harvests on the island.

Issue: How will timber harvesting associated with the Shamrock harvest affect the biodiversity and old growth structure of Kupreanof Island?

Measurement: Biodiversity is a combination of various natural resource attributes including old growth, wildlife, fisheries, critical natural areas, and threatened and endangered species. The measurement of biodiversity includes quantifying these attributes using the following characteristics: changes in the amount and fragmentation of old growth, and affects on wildlife habitat, fisheries, and threatened and endangered species.

6. Watershed

Comments: The NCC and KPC provided recommendations for addressing these natural resources in the EIS. The KPC stated that the recent TTRA legislation addressed questions on watershed/water quality, and therefore new studies of how to apply this policy should not be part of this EIS. The NCC was concerned that the 100-ft buffer strip mandated by TTRA on Class I and II streams may not be adequate to protect temperature sensitive streams from watershed disturbance.

Issue: Will timber harvesting adversely affect the hydrologic balance and water quality of streams in the Shamrock study area?

Measurement: Measures of watershed impacts include harvest area and road miles within each watershed, miles of Class III streams adjacent or within harvest units, and number of road stream crossings. In addition, each watershed was assessed for its sensitivity to management activities.

7. Floodplains

Comments: In addition to their importance for conveyance of floodwater, floodplains by their very nature are prone to disturbance. Consequently, permanent facilities constructed in floodplains must be able to withstand design floods without suffering significant damage.

Issue: Will harvest activities and road construction in the Shamrock area affect the conveyance of floodwater or result in an increase in potential flood damage?

Measurement: The amount of harvest area in floodplains was quantified. Hydrologic studies (see sections on Watershed) assessed the potential increase in floodflows due to harvesting in each watershed.

8. Soils

Comments: Increased soil erosion and sedimentation are potential adverse effects of harvesting and road building in forested areas. In contrast, soil productivity can temporarily increase after harvesting as a result of increased soil warming and nutrient cycling.

Issue: To what degree will soil erosion and sedimentation increase as a result of harvest activities and the construction of roads in the Shamrock area?

Measurement: Each unit and road segment was evaluated for soil hazards. This evaluation was the basis for selection of appropriate logging methods and for determining unit boundaries and road locations to minimize risk of increased erosion and sedimentation.

9. Minerals

Comments: The construction of roads and the harvest of timber could cause impacts to the assessment, development, or operation of existing mining interests or of potential high value mining sites.

Issue: Will timber harvest and road building in the Shamrock area affect mining activities?

Measurement: The presence and location of any active mining claims in the Shamrock area were determined. In addition, the presence of any mineral occurrences in the Shamrock area that have high value or high development potential were identified. The impacts due to harvesting and road construction to any such claims or mineral occurrences are evaluated.

10. Air Quality

Comments: No concerns about air quality were raised during the scoping process or by resource specialists.

Issue: Are there potential air quality impacts due to burning, road construction, or harvest activities?

Measurement: Since extensive burning is not currently planned for the Shamrock area, no assessment of this impact is necessary. An analysis of particulate emissions on unpaved roads was conducted.

11. Subsistence

Comments: The NCC and ADF&G provided comment on the loss of habitat for wildlife and ultimately on subsistence use. ADF&G stated that habitat alteration of the project area, particularly loss of deer habitat, would not benefit subsistence wildlife. Access was a major concern regarding subsistence use. Although increased access would increase opportunities to conduct subsistence activities, it may also result in over-harvest of resources and impact to subsistence activities with inherent religious meaning to native Alaskans.

Issue: To what extent will each alternative effect subsistence resources and use within the study area? (Section 810 of the Alaska National Interest Lands Conservation Act [ANILCA] requires the agency to document a finding on whether there is a significant possibility of a significant impact on subsistence resources and use.)

Measurement: This issue was analyzed according to (1) computer model predictions of the change in abundance and distribution of subsistence resources, (2) change in access to subsistence resources, and (3) changes in competition from non-subsistence users for subsistence resources.

12. Cultural Resources

Comments: No comments were received from the public or agencies; however, cultural resources are frequently an issue in other timber sale EISs.

Issue: Would cultural resources, particularly Native American sites, be impacted by harvesting in the Shamrock area?

Measurement: Literature reviews and field inventories in areas likely to have been previously inhabited or utilized were used to identify and avoid areas of cultural sensitivity. No culturally significant resource sites have been identified in areas proposed for harvest and road building. Mitigation measures will be developed if cultural resources are accidentally encountered during site disturbance.

13. Recreation

Recreational Opportunities

Comments: Forest Service personnel and the interdisciplinary team have discussed the potential to have increased recreational access to the Shamrock area and whether or not the public would consider the increased access and changes in recreational opportunity as a positive aspect.

Issue: What effect will the proposed sale or sales in this area have on recreational opportunities?

Measurement: This issue was evaluated by identifying changes in recreational opportunity, as identified in the Recreation Opportunity Spectrum, and by changes in access to and the experience of the Forest Service inventory of recreation places.

Wild and Scenic Rivers

Comments: The timber industry, the NCC, and individuals commented on rivers considered for the Wild and Scenic status. The Alaska Forest Association stated that no additional rivers should be added to the Wild and Scenic River system. The NCC stated that they support the Wild and Scenic designation of the Castle, Irish/Keku and Tunehean rivers. Other individuals stated that the Wild and Scenic status of rivers within the analysis area may affect the amount of land available for inclusion in the timber base supporting the allowable sale quantity.

Issue: What effects will each alternative have on streams eligible or suitable for "Wild and Scenic River" designation?

Measurement: The indicator for this issue is the effect on the free-flowing characteristics, outstandingly remarkable values, and development within the river corridor, to the degree eligibility and classification would be affected. If the Forest Plan Revision is not completed by the time the Shamrock Record of Decision is signed, this indicator relates to all streams within the Shamrock study area that are eligible for Wild and Scenic River status. If the Forest Plan Revision is completed at the time of the Shamrock Record of Decision, this indicator relates to all streams suitable for Wild and Scenic River designation in the Shamrock study area. Wild and Scenic River issues are addressed in the Recreation sections of this EIS.

14. Visual Resources

Comments: An individual and the interdisciplinary team commented about the impact of the transportation system on the visual resources of the area, and the effect of logging on the viewsheds of the rivers being considered for the Wild and Scenic status.

Issue: To what extent will each alternative influence the landscape character of the analysis area, and to what extent will harvest designs be mitigated to protect visual quality?

Measurement: Visual quality was quantitatively evaluated by Visual Quality Objectives (VQOs), using standardized procedures developed by the Forest Service. Visibility

and visual variety of an area to absorb management activities were considered. The issue was measured from sensitive travel routes and commonly used areas.

15. Economics

Comments: The KPC and NCC provided comments concerning the economic impacts of the Shamrock timber harvest. KPC requested that harvest units are permitted along mainline roads to improve timber sale economics. The NCC was concerned about the cumulative economic impact of all timber sales on Kupreanof Island, particularly whether or not there is a demonstrated need to meet annual market demand.

Issue: Will action alternatives within the Shamrock area include timber harvest(s) that are profitable and meet economic criteria for timber harvests in the Tongass National Forest?

Measurement: Responsiveness to this issue is shown by how well the sale(s) meet the mid-market test for profitability to business and industry, and the investment returns to the government.

Issues Not Addressed in the EIS

Some issues raised by the public are not project specific or are the subject of pending decisions at a higher level of planning. Examples of issues or comments beyond the scope of this document follow:

1. The Forest Plan does not plan sufficient harvest quantities for current mill capacity.

   The Stikine Area has forwarded this comment to the Forest Plan Revision planning team.

2. Several comments either stated or implied support or opposition for certain areas to be designated as Wilderness or Wild and Scenic Rivers.

   Wilderness and Wild and Scenic Rivers are designated by Congress. Recommendations for designation by Congress are made in the Forest Plan, not project specific analyses such as the Shamrock Timber Sale(s).

3. Site specific monitoring should include population estimates of fish or wildlife.

   The Forest Service has developed computer models to estimate population levels and predict effects of habitat loss on populations. The models are based on extensive field work and population figures from the ADF&G. The models are periodically revised based on new information. We think this is a more reasonable approach than trying to count every animal.

4. Harvest of timber in volume classes proportional to occurrence.

   The Tongass Timber Reform Act of 1990 mandates proportional harvest for timber Volume Classes 6 and 7 on the long term timber harvest contracts. Proportionality is not required in this analysis.

City of Petersburg, located 15 air miles east of the Shamrock area

Approvals Required From Other Agencies

The Forest Service has acquired permits from the USACOE and the Alaska Department of Environmental Conservation (ADEC). The following permits are on file at the Stikine Area Supervisor's Office:

U.S. Army Corps of Engineers
A single permit from the USACOE incorporates requirements for the Clean Water Act and the Rivers and Harbors Act. It also includes USEPA permits for pollution discharge elimination and spill prevention control and countermeasure. In addition, the USACOE permit covers the ADEC Certificate of Reasonable Assurance for compliance with Alaska water quality standards. This permit was issued for the Little Hamilton log transfer facility in 1982.

State of Alaska Division of Governmental Coordination (ADGC)
A review coordinated by ADGC determines whether the State agencies agree with the Forest Service determination of consistency with the Alaska Coastal Zone Management Plan.

The permit for the log transfer facility that may potentially be used for the sale(s) planned in the Shamrock area has already been obtained, along with the State tidelands easement for the use of State tidelands. The Little Hamilton Bay permit expires in 2017.

Chapter 2

Alternatives

Chapter 2

Alternatives

This chapter summarizes the development of alternatives for harvest of timber from the Shamrock area for the timber sale program of the Petersburg Ranger District, Stikine Area, Tongass National Forest. The five alternatives selected for this study are discussed, compared and evaluated. After this comparison, identification of the Forest Service preferred alternative (Alternative 5) is presented. Specifically, this chapter presents the following information:

- alternative formulation process,
- alternative development for the Shamrock area,
- alternatives considered but eliminated from detailed study,
- common features and design elements of the action alternatives,
- detailed descriptions of alternatives, and
- a summary comparison of alternatives presented in table format.

Alternative Formulation Process

When planning a timber sale, a group of specialists known as the interdisciplinary team (ID Team) meets and discusses how best to accomplish the goal described in the "Purpose and Need" section of Chapter 1. They design alternatives around themes that provide different approaches to the project purpose and need and the issues raised in the scoping process. Where one alternative could emphasize high volume harvest, another alternative could emphasize maintaining visual quality of an area. The National Environmental Policy Act (NEPA) regulations (40 CFR 1502) mandate consideration of all reasonable alternatives for a proposed action, including identification and discussion of alternatives eliminated from detailed study.

When developing alternatives, the ID Team utilizes comments and concerns expressed by the public during the scoping process. These comments are consolidated into major issues, and the ID Team then develops strategies that could be used to resolve these issues, and yet respond to the purpose and need of the proposed action. The ID Team also identifies indicators to measure or compare how each alternative responds to the issue for which it was developed.

Alternative themes are then developed from combining issues and selecting harvest units and roads that accomplish the intent of the theme and the purpose and need of the timber harvest. These themes are formulated into action alternatives.

A primary source of information for selecting areas to harvest timber, build roads and respond to specific environmental elements is a computer-based resource map inventory. Maps are produced that display areas of commercial timber, hazardous soils, Class I and II streams, and other resource values. From these maps, units and roads are designed that best respond to the theme developed for each alternative. The information obtained from the maps is confirmed in the field and maps are corrected when appropriate. Additional factors observed in the field, but not available in map format, are incorporated into selection and design of units and roads for alternatives.

Alternative Development for the Shamrock Area

Planning for the Shamrock harvest began in December 1991 when the Notice of Intent was published in the Federal Register. An ID Team was then selected by March 1992 to carry out the interdisciplinary process for alternatives development and prepare the necessary resource reports and Environmental Impact Statement (EIS).

Public scoping began with the Notice of Intent and continued through July 1992. Notices were placed in local newspapers in May, and Scoping Brochures were mailed to the public and placed in local Forest Service offices and the public library. A telephone contact was available throughout the summer months. In July, public comments were consolidated into specific issues through the preparation of a Scoping Report (Gunther, 1992). The issues identified from public scoping comments are summarized in Chapter 1.

The resource specialists of the ID Team consulted maps, publications and other technical professionals familiar with Kupreanof Island to obtain detailed information about the Shamrock study area. Field surveys were then conducted to collect site specific data and confirm the accuracy of information previously reviewed.

ID Team meetings occurred throughout the data review and collection process to coordinate and integrate concerns expressed by the public, agencies, environmental groups, industries, and resource specialists. A preliminary harvest plan was developed from aerial photos and limited ground truthing to locate harvest areas and tentative road locations. This latter effort resulted in a preliminary unit pool, consisting of 67 timber harvest units of approximately 3,900 acres and 78 million board feet (MMBF) of timber. The road pool consisted of approximately 90 miles of roads.

Following preparation of the Scoping Report and initial field inventory, the ID Team met to review issues of concern and develop themes for alternatives. Issues were grouped into themes, and specific harvest units and roads were selected that best accomplished the objective of each theme. Themes were developed into action alternatives with unique objectives. Throughout the next few months, units and roads were added, dropped, and modified for each of the alternatives based on specific resource concerns, field observations, costs of timber harvest and road construction, and intent of each of the alternatives. The process concluded when costs of alternatives were minimized to the extent possible, and resource concerns and objectives were satisfied.

Alternatives Considered but Eliminated from Detailed Study

The ID Team initially considered more themes and alternatives than the final four action alternatives and one no action alternative that were evaluated for detailed study. The alternatives eliminated and the rationale for not considering them further in the ID Team process are described below.

Unevenaged-Management

During initial ID Team meetings, alternative silviculture cutting methods were considered for many of the harvest units in the alternative pool for promoting biodiversity and maintaining as nearly as possible the current stand structure that exists in old-growth timber stands in the Shamrock area.

After analysis of the vegetative conditions of each potential harvest unit, the use of unevenaged-management on a large scale was dropped from further consideration for several reasons (Seaberg, 1993). Silvicultural objectives to achieve vigorous, early successional timber stands would not be obtained, and the risk of windthrow and reinfecting residual timber with dwarf mistletoe precluded alternative silvicultural methods as a viable action alternative in itself. Additionally, the costs were prohibitive. However, partial cutting, primarily in the form of green tree retention was presented for a few units within each action alternative where conditions were considered conducive to alternative silviculture and where it would help meet specific visual and wildlife resource objectives.

Harvesting Timber in the Northeast Shamrock Area

During the preliminary planning stage of this analysis, potential harvest units were considered on the north-facing slopes of the unnamed creek that drains into Duncan Canal south of Taylor Creek. Examination of aerial photos and several aerial flights over the area indicated that the area had a high potential for mass-movement of soils. Side slopes are very steep, and there is evidence of mass wasting. The ID Team decided not to enter this area at this time.

Harvesting Timber in the Irish/Keku Creek and Tunehean Creek Area

During the preliminary planning process, potential harvest units were identified in the western portion of the analysis area in the vicinity of Irish Creek and Tunehean Creek. Entering these units was deferred at this time due to the necessity of extensive road construction through non-commercial forest land to access the better timber. Deferring entry in this portion of the Shamrock area also addresses biodiversity concerns related to maintaining large, contiguous areas of old-growth forest that would be unharvested. In addition, the proximity of the proposed Irish Lakes Semi-Primitive Area and the Wild and Scenic River eligibility of the Irish Creek/Keku Creek and the Tunehean Creek drainages precluded consideration of these areas at this time. Once the Wild and Scenic River issue has been resolved in the Forest Plan Revision, a realistic transportation and harvesting system might then be developed for this area.

Activities Associated with Timber Harvest

This EIS describes the effects of activities associated with harvesting timber. Basically, timber harvesting is the process by which trees are cut into logs and transported to a manufacturing facility, such as a sawmill or pulp mill. The major activities involved in a National Forest timber sale are summarized below:

Road Construction

This process involves the construction of logging roads needed to harvest the timber. It includes development of rockpits and quarries from which rock is obtained to construct specified roads for long-term use, and temporary roads and landings needed to harvest timber.

Falling and Bucking

This process involves the cutting of trees (falling/felling) and cutting felled trees into logs of desired lengths (bucking). This activity would occur under all action alternatives and would not vary by alternative or harvest unit.

Yarding

This is the process of moving logs from the stump to a landing or other point of transportation. The type of yarding would vary by harvest unit and alternative. Yarding logs is accomplished using ground-based equipment, cable logging systems, or helicopters. The method used is dependent on such factors as cost, topography, slope, resource protection needs, and access.

Ground based systems include tractor and shovel yarding. Tractor yarding has generally been considered unacceptable in Southeast Alaska, but rubber-tired skidders are used under certain circumstances (along roads, frozen ground, etc.). Low-pressure ground skidding equipment such as light flotation forwarders have had limited use in Southeast Alaska, but under the right conditions can accomplish skidding with acceptable impacts to soils. In general, these ground based systems on the moist and soft soils within the Shamrock area would be difficult and potentially damaging to soils. However, Harvest Unit 40 was identified as one area where low-pressure ground skidding could be accomplished without damage to the soil resource.

Shovel logging is the process of moving logs from the stump to the landing by repeated swinging with a swing-boom loader. The loader is moved from the haul road into the harvest unit. Logs are decked progressively closer to the haul road with each pass of the loader until they are finally decked at roadside. For this system to be used effectively, slopes should be less than 20 percent. Several units or portions of units have been identified as appropriate for shovel logging.

Cable logging systems include highlead and slackline-skyline systems. Highlead and slackline systems are used to yard logs both up and down hill:

> Logs yarded by highlead systems are generally dragged on the ground with some lift to one end (hence the term "highlead") because of the lift provided by the tower height (generally 60-90 feet). Drag corridors radiate away from the landing to the edge of the setting boundary, which tends to disperse runoff where uphill yarding is used and concentrate runoff where downhill yarding is used. There is a possibility of more ground disturbance using downhill highlead yarding, because there is less control yarding logs to the landing. Downhill yarding, however, is often preferable to constructing roads that are environmentally and economically unacceptable.
>
> Skyline systems or slackline systems in a skyline configuration are able to lift one end of the log or completely suspend the logs, reducing the amount of ground disturbance. High-lead yarders or small grapple yarders can accomplish this if yarding distances are short and the topography is favorable. Slackline systems can increase yarding distance capability, but are more expensive.

Helicopter yarding also moves logs from the harvest unit to landing. Total suspension of logs is achieved, resulting in the least amount of soil impact. Helicopter yarding is the most expensive of all yarding systems considered in this project and is considered only when road costs to more remote areas would exceed helicopter costs.

Sorting and Loading

This process involves the sorting of logs by grades and species either at a landing or a dry sort area, and placing logs on logging trucks. A dry sort area is a central area outside a harvest unit used to sort logs before hauling to a log transfer facility (LTF). Several potential locations for sorting logs were identified by the ID Team.

Log Hauling

This process involves transporting logs from a landing to an intermediate sorting area, and eventually to a log transfer facility (LTF). If a mill were on the island, logs would be hauled directly to a mill (i.e., Wrangell Island)

Dumping and Rafting

This is the process of bundling, dumping, and rafting logs into the water at an LTF. The existing Little Hamilton Bay LTF and rafting area would be used by all action alternatives for the hauling and dumping of logs harvested in the Shamrock area.

Log Towing

This is the process of towing logs with tugboats from the LTF to the manufacturing facility. Logs are usually assembled into rafts consisting of 50-75 bundles (truck loads), which are then towed to manufacturing facilities. Sometimes logs are loaded onto barges for towing.

Design Elements Common to All Action Alternatives

Windfirm Boundaries

All units were designed to minimize windthrow. Boundaries were located to take advantage of topographical features and vegetative conditions that provided protection from wind. Natural windfirm areas such as muskegs were used as boundaries when available.

Water Quality

The Tongass Timber Reform Act of 1990 (TTRA) requires a buffer zone of no less than one hundred feet in width on each side of all Class I streams and on those Class II streams which flow directly into Class I streams. This feature is incorporated into all action alternatives where harvest units are adjacent to these streams. The streams and their respective buffers are located outside of harvest units. Measures to protect other streams include directional falling of trees away from streams, partial suspension of logs, split-yarding and removal of logging debris from stream courses.

Rockpits

The design of rockpits along Road 6314 (the principal arterial for all action alternatives) would incorporate features such as screening and rehabilitation of pits where practical to mitigate visual impacts. Rockpit and roadside rehabilitation would be applied as needed, and may include the planting of tree seedlings and spraying of rock weathering agents to allow a better blending with the natural surroundings.

Maintenance Yards

Two sites to the north outside of the Shamrock area were identified as potential maintenance yards. These sites are located approximately 9 and 13 miles, respectively, from the Little Hamilton Bay LTF. Both sites would require an overlay of quarry rock, perimeter ditching and catchment basins; and where appropriate, protection measures would be taken to prevent penetration of oil and other deleterious materials into the soil.

Sort Yards

Two potential sort yard sites were identified within the Shamrock area. One site would be located on Road 6314, approximately 0.2 miles north of the intersection with Road 45803. The second site would be located adjacent to Road 6314, approximately 0.4 miles north of Unit 28. Both sites would have the same requirements for rock overlay, etc. as those described for the maintenance yards.

Road Location

Roads were located using BMPs that minimize soil and water resource impacts (see Road Descriptions in Appendix B). Road locations avoid alluvial floodplains and landslide prone areas to the greatest possible extent. Roads were located at the base of slopes through noncommercial forest land to avoid construction in muskeg. Stream crossings were located perpendicular to the channel to minimize the amount of clearing within the stream influence. Full bench road construction and endhauling of excess excavated material would be required on designated areas for soil stability.

Green Tree Retention

Portions of several harvest units were identified where live trees would be left uncut or partially harvested, leaving at densities varying between 5 and 15 trees per acre. Based on recommendations made by the project wildlife biologist, portions of Unit 7 would leave 5 trees per acre uncut. These trees were left to provide structural diversity for wildlife and a genetic legacy for the future stand. The project landscape architect recommended that portions of harvest units retain 15 trees per acre to soften the visual effects of large openings. Unit 55 would have 5 acres left uncut to reduce visual impacts. See Unit Descriptions in Appendix A for specific areas where green tree retention has been proposed.

Snag Retention

Where safe and feasible, snags would be retained to provide wildlife habitat for cavity nesting birds and a future downed wood material source. In units proposed for helicopter yarding (Units 31, 32, and 33), snag retention was recommended by the project landscape architect to soften the visual effects of large harvested openings. See Unit Descriptions in Appendix A for specific areas where snag retention has been proposed.

Retention Areas

Areas to be retained as old-growth habitat for the life of the project have been designated in each VCU. These areas were chosen based on their value to Sitka black-tailed deer, marten, and black bear, which were selected as MIS species for the Shamrock analysis. Three retention areas have been designated in VCU 429, and two each in VCUs 436 and 438, ranging in size from 1,600 to 2,900 acres. These retention areas are of sufficient size to serve also as small Habitat Conservation Areas (HCAs) as defined by Suring, et al. (1992). These small HCAs would be part of a larger network of other HCAs, including large (≥ 20,000 acres) and medium (≥ 5,000 acres) HCAs, that provide a landscape-level strategy for protecting the population viability of old-growth dependent animals species. Although each retention area would be of sufficient size to meet retention goals in its respective VCU, designation of more than one HCA per VCU would be appropriate for meeting the objectives of population viability as discussed by Suring et al. (1992).

Cultural Resources

All known or discovered cultural sites would be protected as required by statute. The timber sale contract would require immediate protective measures if sites are discovered during timber harvesting and road construction.

Enhancement Opportunities

A number of recreation opportunities were identified in the Shamrock area. These opportunities are listed here only to document the ideas; they are not part of the proposed action or any of the action alternatives. Additional NEPA analysis would be required to approve construction.

Kupreanof Island Map/Guide - A guide to the recreational opportunities on Kupreanof Island could be prepared for public use. The map would direct use to appropriate areas and developed facilities, and educate the public regarding timber harvesting activities and regulations.

Trailhead and Trail to Irish Lakes - Irish Lakes have been identified as a Recreation Place by the Forest with the potential for trailhead and trail development. The lakes are also the focal point for the Semi-Primitive (SP) Land Use designation identified in the Forest Plan Revision. A trailhead could be located in Harvest Unit 42 with a parking area established in a rockpit proposed for the site. Included in this proposal would be a boardwalk hiking trail, small day use/overnight area with a picnic table and platform/shelter, and a boat and small dock at the larger lake.

Viewpoint, Trailhead and Trail at Unnamed Lakes - Proposed Road 6314 passes to the west of the smaller of the unnamed lakes sometimes referred to as Kluane Lakes. Thus there is an opportunity for vehicle access within close proximity to the lake shore. Included in this proposal would be a turnout/viewpoint along the main road which would serve as a small parking area and trailhead. A handicap-accessible, boardwalk trail to the lakeshore and around the two lakes could be constructed.

Castle River Trail - To provide longer trail opportunities and create public access to the upper Castle River, a trail could be constructed from Road 6314 (near Unit 83, Alternative 5) along the Castle River. This trail could be extended to connect to the Irish Lakes Trail using the established roadway.

Indian Point Cabin - The Indian Point cabin site is located within the Shamrock area, but is outside of any potential sale area for the action alternatives. This site is planned for future development.

Unit Size

Each alternative contains some harvest units that exceed 100 acres. Current regional direction in the Alaska Regional Guide (USDA Forest Service, 1983) states that:

> One hundred acres is the maximum size of created openings to be allowed for the hemlock-Sitka spruce forest type of coastal Alaska, unless excepted under specific conditions. Recognizing that harvest units must be designed to accomplish management goals, created openings may be larger where larger units will produce a more desirable contribution of benefits.

Reasons for larger unit sizes are provided below for the action alternatives.

North Irish Reoffer

The original North Irish timber sale defaulted and was terminated by the Forest Service on May 18, 1992. The remaining volume and roads on the sale were reanalyzed with the North Irish Reoffer (NIR) Environmental Assessment to determine whether any change in the original sale design was warranted. A Decision Notice on the NIR was made on September 30, 1993. After an appeal by the Organized Village of Kake, the Forest Supervisor withdrew the NIR Decision Notice on January 21, 1994. The Forest Service is now proposing to incorporate one road segment and associated Harvest Unit 9 of the NIR into the Shamrock Timber Sale rather than modify the NIR Environmental Assessment and issue a new Decision Notice. The Shamrock DEIS Supplement analyzed the specific impacts of this road and harvest unit as part of the Shamrock Timber Sale.

Alternatives Considered in Detail

The ID Team developed four action alternatives for detailed analysis. Alternatives address the purpose and need of the Shamrock harvest and respond to resource management opportunities such as timber harvest and recreational opportunities. Each alternative provides a mix of resource use and protection, emphasizing different resource values, based on the theme for which the alternative was developed.

If an action alternative is selected and a timber sale is implemented for the Shamrock area, minor changes to units and roads are likely. Maps displayed at the end of this chapter (Figures 2-1 to 2-5) show general size and location of proposed harvest units. Timber volumes presented for each of the action alternatives are based upon information available at this time. An intensive cruise will be conducted on the acreage made available for a timber sale, which would determine actual timber volume. A description of each alternative is provided which includes:

- the intent of the alternative;
- the guidelines used in selecting units and roads that are consistent with the themes;
- a summary discussion of how the alternative addresses the issues raised in public scoping, as described in Chapter 1;
- a table summarizing the volume of timber harvest by VCU and the acres to be harvested by logging method;
- a table showing specified, spur, and total road mileage; and
- a discussion of the individual harvest units that may exceed 100 acres.

After the alternatives had been developed, each was evaluated relative to the purpose and need, environmental impacts, and potential benefits or opportunities. This process resulted in Alternative 5 being selected as the Preferred Alternative by the Forest Service. A more detailed discussion of the selection process follows the descriptions of alternatives.

No Action (Alternative 1)

This alternative does not propose any timber harvest or road construction in the Shamrock area (Figure 2-1). Substitute volume may or may not be available from some other area on the Tongass National Forest. Management of the Shamrock area would continue as it currently exists. A no action alternative is required in an EIS under NEPA. This alternative serves as the benchmark by which effects of the action alternatives are measured.

Issues associated with this alternative include:

Transportation: Road access would remain restricted to the north end of the Shamrock area in the vicinity of the North Irish Timber Sale.

Wildlife: There would be no changes to wildlife habitat suitability caused by man.

Fish: There would be no potential impacts to water quality and fish habitat.

Biodiversity and Old-Growth: Large old-growth forests and forest fragmentation in the Shamrock area would remain as presently occurs.

Watersheds: Watersheds would be unaltered from existing conditions.

Soils: Soils would only be affected by natural processes.

Subsistence: Subsistence use would not be affected.

Cultural Resources: Cultural resources would not be disturbed.

Recreation: There would be no change in the current recreation opportunity spectrum.

Wild or Scenic Rivers: The eligibility and classification of the Castle River, Tunehean Creek, and Irish/Keku Creek would not be affected.

Visual Resources: All inventoried VQOs would be met under this alternative. Views from visually sensitive locations would not be altered by timber harvest activities. The characteristic landscape would not be modified except for natural successional changes in vegetation.

Economics: The 22 to 55 MMBF of Stikine Area's independent timber sale program would not be available in Fiscal Year 1996.

Alternative 2

This alternative proposes to harvest a high volume of timber over a broad portion of the Shamrock area and develop the planned transportation system between the north and south portions of Kupreanof Island. To maximize timber production and minimize road costs, 6 harvest units (20, 24, 29, 31, 32, and 81) are located within one quarter mile of Castle River and 1 unit (51) is located within one quarter mile of Tunehean Creek, which are eligible for Wild and Scenic River designation. Although harvesting is currently restricted in the river corridors, final determination of the recommendation or non-recommendation of these rivers as suitable for designation depends on the selection of alternatives proposed in the proposed Forest Plan Revision. Alternative 2 of the Shamrock EIS was developed to plan some harvest in river corridors in the event they were not recommended for inclusion into the National Wild and Scenic River System.

If the Forest Plan Revision is not completed prior to this project, these seven units would have to be deleted from the project if this alternative is selected in order to protect the eligibility of these Rivers for Wild and Scenic River designation. If this occurred, the timber volume for this alternative would be overstated by approximately 9 MMBF and the acres harvest by 428 acres.

A list of all proposed harvest units and acres by alternative is shown in Table 2-1. Implementation of this alternative would schedule harvest of 2,702 acres in 42 units for 54.8 million board feet (MMBF) of net sawlog volume (Table 2-2). To implement this alternative, approximately 49 miles of new road would be constructed (Table 2-3).

Table 2-1
Harvest Units and Acres by Alternative

Unit #	Acres	Alt 2	Alt 3	Alt 4	Alt 5
1	10	X	X	X	X
2	26	X	X	X	
3	38	X	X	X	
4	26	X	X	X	
5	45	X	X	X	X
6	88	X	X	X	X
7	48	X	X	X	X
8	28	X	X	X	X
10	59	X	X	X	X
11	32	X	X	X	
13	102	X	X	X	X
14	91	X	X	X	X
15	57	X			X
20	48	X			
20M	27		X	X	X
22	55	X			X
23	81	X			X
24	48	X			
25	88	X	X	X	X
28	177	X		X	X
29	81	X			
31	109	X			
32	156	X			
33	77	X			
35	40	X		X	X
36	114	X		X	X
37	66	X		X	X
40	43	X		X	X
42	70	X	X	X	X
43	20	X	X	X	X
45	60	X	X	X	X
46	43	X	X	X	X
47	11	X	X	X	X
48	66	X		X	X
50	89	X	X	X	X
51	55	X			
51M	43			X	X
52	41	X		X	
54	34	X	X	X	X
55	59	X			
61	113	X			X
77	31	X	X	X	
81	67	X			
82	26				X
83	44				X
NI9	110	X	X	X	X

Table 2-2

Proposed Timber Harvest for Alternative 2 by VCU and Logging Methods

VCU	Estimated Volume (MBF)	High-lead (acres)	Skyline (acres)	Shovel (acres)	Helicopter (acres)	Total (acres)
429	21,564	1001	171	25	0	1,197
436	23,684	449	119	106	342	1,016
438	9,526	255	234	0	0	489
Total	**54,774**	**1,705**	**524**	**131**	**342**	**2,702**
Percent of Total		63.1%	19.4%	4.8%	12.7%	100%

Table 2-3

Road Mileage to be Constructed for Action Alternatives[1]

	Collector Roads	Local Roads	Total Specified Roads	Temporary Roads (Spurs)
Alternative 2	21.0	21.3	42.3	6.3
Alternative 3	13.8	10.9	24.6	3.3
Alternative 4	21.1	12.8	33.8	5.8
Alternative 5	18.3	15.5	33.8	4.8

[1] Specified roads will remain after completion of the sale; temporary roads will be closed following the sale.

Figure 2-2 shows the spatial relationship among the roads, units, and other geographic features of the Shamrock area.

Guidelines for selecting units and roads that are consistent with the theme of dispersing harvest activities include:

- Emphasize long-term timber production and road access through developing access to the watersheds in the Shamrock area.

- Select harvest units throughout the length of Road 6314 to develop long-term transportation links to other areas.

Issues associated with this alternative include:

Transportation: This alternative provides the most access to new areas, with 42 miles of new permanent road, which would increase road density to 0.26 miles per square mile of land area. Implementation of Alternative 2 would provide a link from the village of Kake and the Little Hamilton Bay LTF to a potential road system connecting to the southern portion of the island.

Wildlife: Among the action alternatives, Alternative 2 would result in the greatest reduction in suitable habitat for marten and black bear (-7.3 and -5.7 percent respectively) and in marginal habitat for marten and Sitka black-tailed deer (-5.2 and -5.5 percent respectively). Marginal habitat for black bear would increase 4.5 percent. For all three species, protected carrying capacity would decline the most under all action alternatives. River otter and bald eagle habitat would be unaffected by this alternative.

Fish: Alternative 2 would present the greatest effects on water quality. There would be 3.86 miles of Class III streams occurring within harvest units, and there would be 24 road crossings of Class I and Class II streams and 82 crossings of Class III streams. Under this alternative 1,174 acres would be harvested in the Castle River watershed and 437 acres in the Tunehean Creek watershed, which have the potential for temperature sensitivity problems. This alternative would provide the most potential temperature effects.

Biodiversity and Old-Growth: This alternative would harvest the greatest amount (2,537 acres) of old-growth forest habitat.

Watersheds: Of all the action alternatives, Alternative 2 would have the largest overall impact on watersheds. Average percentage of watershed area harvested would be 3.2 percent and there would be a substantially higher percentage of the Castle River watershed harvested compared to the other alternatives.

Soils: Harvested areas with high potential for mass movement is estimated at 676 acres. Mitigation to address this potential hazard includes partial suspension yarding and full bench road construction and endhauling.

Subsistence: A significant restriction of subsistence use of deer is anticipated with this and all action alternatives, primarily due to increased competition for deer resulting from increased access and secondarily due to a decrease in abundance of deer. No other subsistence resources are expected to be significantly affected.

Cultural Resources: The potential to impact unknown cultural resources is greatest for this alternative because more acreage is disturbed than any other alternative.

Recreation: Alternative 2 would provide the most acres (29,190) of roaded modified opportunity acres (for example, for mountain biking, hiking, off-road vehicle use, and increased access to lakes). The amount of primitive opportunity acres would be 16,829 acres, similar to Alternatives 4 and 5.

Wild and Scenic Rivers: This alternative would result in portions of Harvest Units 20, 24, 29, 31, 32, 51, and 81 being located within one quarter mile of

Castle River and Tunehean Creek, which are study rivers. Road construction and timber harvest within the Wild and Scenic River corridor (one quarter mile on each side of the river) is not permitted unless the rivers are found unsuitable for inclusion in the Wild and Scenic River System. This decision is now being determined through the revision of the Forest Plan.

Visual Resources: In the background distance zone from Duncan Canal, 192 acres of harvest units are visible. From the Tebenkof (southern) small plane route, 1,344 acres are seen in the middleground distance zone and 490 acres in the background distance zone. The majority of the units meet the inventoried VQOs. Green tree and snag retention are proposed in several harvest units as mitigation.

Economics: The timber value estimated from the mid-market analysis would be $ -144 MBF. This analysis is for comparative purposes and does not represent the estimated total value ($ -8.7 million) of the alternative. Of all the action alternatives, this alternative would present the highest value per MBF (least negative) in terms of estimated feasibility. Because more timber volume would be produced than any other alternative, Alternative 2 would create the highest number of jobs.

Optional Road Access to Units 31, 32 and 33

Initially the ID Team proposed roads to access Harvest Units 31, 32 and 33 within the South Castle Creek watershed. These harvest units were located in areas that had been considered for harvest in a previously-planned project, the Totem Bay Timber Sale (1984). To access this area from the planned Shamrock road system, 7 miles of new construction would be needed. The ID Team concluded that helicopter yarding these areas to a landing in Unit 29 would be more cost effective than constructing a road to the units.

However, the most logical transportation flow from these units would be south to a potential LTF at the south end of Kupreanof Island. This LTF and a potential transportation system to the south are not confirmed at this time. Access from the south would be through an eligible Wild and Scenic river corridor. Thus a road could not be constructed until the current Forest Plan revision decides the eligibility issue. In the event the road system is developed from the south for a future project, constructing roads to access Units 31, 32 and 33 would therefore be more cost-effective. This type of road system was planned and analyzed in the Totem Bay Environmental Assessment Report (1984).

The lower slopes of Units 31, 32 and 33 could be harvested using conventional logging systems if a road is constructed. However, to harvest these units in their entirety, helicopter yarding and slackline cable systems would likely be necessary.

Units Over 100 Acres

Seven units ranging in size from 102 to 177 acres are included in Alternative 2. The reasons these units are greater than 100 acres are shown in Table 2-4.

Alternative 3

This alternative was designed to concentrate timber harvest in the northern half of the Shamrock area, leaving large blocks of old-growth and watershed unharvested in the southern half. No timber harvest is proposed in the corridor of any river considered

Table 2-4
Units Greater than 100 Acres in Size

Unit	Acres	Alternative	Factors Considered
13	102	2, 3, 4, 5	This harvest unit exceeds 100 acres to develop a cost feasible entry on this road system. Leaving timber above the proposed unit would isolate timber, making it more costly to log this isolated timber in future entries. Further, isolated timber at the top of this unit would be vulnerable to windthrow if not harvested. Unit would not be seen from saltwater travel routes or small plane routes. Unit would meet modification and maximum modification VQOs.
28	177[1]	2, 4, 5	This harvest unit exceeds 100 acres to prevent excessive windthrow risk in residual stands. The identical area was examined during the analysis of the Totem Bay Timber Sale (1984) and a 430 acre harvest unit was proposed. This unit size was proposed due to similar concerns about windthrow risk in the residual stands. A smaller area (177 acres) is proposed in the Shamrock analysis at the northern end of the Totem Bay unit. The south boundary of this unit generally follows openings (created by windthrow) to create a relatively windfirm boundary. Unit would be seen in the middleground distance zone of the southern small plane route, but would meet maximum modification VQO.
31	109	2	This is a helicopter unit located in the South Castle River drainage. The unit exceeds 100 acres to avoid isolating timber for future entries and to reduce windthrow risk to residual timber. Use of helicopter logging techniques will eliminate visual impacts due to road construction. Unit would meet modification VQO.
32	156[1]	2	This is a helicopter unit located in the South Castle River drainage. The unit exceeds 100 acres to avoid isolating timber for future entries and to reduce windthrow risk to residual timber. With elimination of road construction due to helicopter logging and with retention of snag trees at 5 trees per acre, unit would meet the modification VQO.
36	114	2, 4, 5	This unit is proposed for cable logging at the end of a forest system road. The unit size exceeds 100 acres to make a feasible logging entry and to avoid isolating timber. Implementation of green tree retention along the access road at a rate of 15 trees per acre would reduce the visual appearance of size, and the unit would meet the modification VQO.
61	113	2, 5	This unit is proposed for cable logging near the end of a long road. The unit size exceeds 100 acres to make a feasible entry and to avoid isolating timber. This unit ties into existing muskegs and openings on a ridgetop. With green tree retention along the north boundary and portions of the access roads, the unit would meet the modification and maximum modification VQOs.
NI9	110	2, 3, 4, 5	This unit is over 100 acres to prevent excessive windthrow risk in adjacent residual stands. The unit boundary uses topographic and vegetative features, where available, to minimize blowdown potential.

[1] Units greater than 150 acres require authorization by the Regional Forester.

eligible for Wild and Scenic River designation. Harvest would be minimized in the Castle River and Irish/Keku creek drainages.

Implementing Alternative 3 would schedule harvest of 1,176 acres in 23 units for approximately 22.3 MMBF of net sawlog volume (Table 2-5). To implement this alternative, approximately 28 miles of road would be constructed (Table 2-3). Figure 2-3 shows the spatial relationship among the roads, units, and other geographic features of the Shamrock area.

Guidelines used in selecting units and roads that are consistent with the theme of intensive management focused in the northern half of the Shamrock area are provided below.

- Exclude the quarter mile corridor of the Castle River and Tunehean Creek from timber harvest and road construction.
- Concentrate individual harvest units in fewer watersheds which are restricted to the northern half of the Shamrock area.
- Concentrate access in the northern half of the Shamrock area, providing motorized recreation opportunities in this area, while the southern portion of the Shamrock area would be managed to emphasize primitive or semiprimitive opportunities.
- Limit harvest and road construction in the Castle River drainage.
- Locate timber harvest so that units are not visible from Duncan Canal.

Table 2-5
Proposed Timber Harvest for Alternative 3 by VCU and Logging Method

VCU	Estimated Volume (MBF)	Highlead (acres)	Skyline (acres)	Shovel (acres)	Helicopter (acres)	Total (acres)
429	12,410	560	124	25	0	709
436	3,248	84	0	62	0	146
438	6,641	193	128	0	0	321
Total	**22,299**	**837**	**252**	**87**	**0**	**1,176**
Percent of Total		71.2%	21.4%	7.4%	0.0%	100.0%

Issues associated with this alternative include:

Transportation: Of all action alternatives, the least amount of road miles would be constructed, allowing less access to new areas. Collector Road 6314 would be constructed approximately halfway through the Shamrock area.

Wildlife: Wildlife habitat would be least affected by Alternative 3. Suitable habitat would decline 2.6 percent for marten and 2.3 percent for black bear. Marginal habitat for marten and Sitka black-tailed deer would decline around 2 percent. Marginal habitat for black bear would increase 1.8 percent.

Declines in predicted carrying capacity would be the least for all three species among the action alternatives. River otter and bald eagle habitat would be unaffected by this alternative.

Fish: Alternative 3 would present the least potential effect on water quality. There would be 1.9 miles of Class III streams within harvest units, and this alternative would require 16 road crossings of Class I and Class II streams and 47 crossings of Class III streams. The least amount of harvest would occur in the Castle River (144 acres) and Tunehean Creek (0 acres) watersheds which have potential for temperature sensitivity problems.

Biodiversity and Old-Growth: This alternative would harvest the least amount of old-growth forest habitat, estimated at 1,071 acres.

Watersheds: Alternative 3 would have the least effect of all the action alternatives on watersheds, with an average of 1.6 percent of area harvested per watershed.

Soils: Harvested areas with high potential for mass movement is estimated at 294 acres. Mitigation to address this potential hazard includes partial suspension yarding and full bench road construction and endhauling.

Subsistence: A significant restriction of subsistence use of deer is anticipated with this and all action alternatives, primarily due to increased competition for deer resulting from increased access and secondarily due to a decrease in abundance of deer. No other subsistence resources are expected to be significantly affected.

Cultural Resources: The potential to impact unknown cultural resources is less than any other action alternative.

Recreation: This alternative would convert the least amount of acres to "roaded modified (11,617 acres)." Primitive acres would be the highest of the action alternatives (46,803 acres).

Wild and Scenic Rivers: No harvest units or roads would be located within one quarter mile of any river eligible for Wild and Scenic River designation.

Visual Resources: From the Tebenkof plane route, 32 acres of harvest units could be seen in the middleground distance zone and 264 acres could be seen in the background distance zone. All units would meet the inventoried VQOs for this alternative.

Economics: The timber estimated value from the mid-market analysis would be $ -190/MBF. This analysis is for comparative purposes and does not represent the estimated total value ($ -4.7 million) of the alternative. Of all the action alternatives, this alternative represents the least feasible economics based on net value per MBF. Alternative 3 would create 217 jobs, the least amount of all the action alternatives.

Units Over 100 Acres

Alternative 3 includes Harvest Units 13 and NI9 which have proposed sizes of 102 and 110 acres, respectively (Table 2-4).

Alternative 4

The theme of this alternative is to construct a major transportation system through the Shamrock area, while avoiding the corridor of those rivers considered eligible for Wild and Scenic River designation. This alternative minimizes impacts to the Castle River drainage and has more harvest and roads compared to Alternative 3, but less harvest and roads than Alternative 2.

Implementation of Alternative 4 would schedule harvest of 1,766 acres in 31 units for approximately 33.9 MMBF of net sawlog volume (Table 2-6). To implement this alternative, approximately 40 miles of road would be constructed (Table 2-3). Figure 2-4 shows the spatial relationship between roads, units, and other geographic features of the Shamrock area.

Table 2-6
Proposed Timber Harvest for Alternative 4 by VCU and Logging Method

VCU	Estimated Volume (MBF)	Highlead (acres)	Skyline (acres)	Shovel (acres)	Helicopter (acres)	Total (acres)
429	21,364	989	171	25	0	1,185
436	5,848	168	30	62	0	260
438	6,641	192	129	0	0	321
Total	**33,854**	**1,349**	**330**	**87**	**0**	**1,766**
Percent of Total		76.4%	18.7%	4.9%	0.0%	100.0%

Guidelines used in selecting harvest units and roads for this alternative, with the theme of selecting units close to Road 6314, include:

- Exclude the river corridor area of those rivers eligible for Wild and Scenic River designation from timber harvest and road construction.
- Limit harvest and road construction in the Castle River drainages so that the amount harvested would be intermediate between

Alternatives 2 (the greatest amount of timber harvest) and 3 (the least amount of timber harvest).

- Locate harvest units throughout the length of Road 6314 which would provide a transportation link between the southern and northern portions of the island.

- Locate timber harvest so that units are not visible from Duncan Canal.

Issues associated with this alternative include:

Transportation: This alternative provides the second highest access to new areas, resulting in construction of 34 miles of permanent road and increasing roaded density to 0.21 miles per square mile of land area. Implementation of Alternative 4 would provide a link from the village of Kake and the Little Hamilton Bay LTF to a potential road system connecting the southern portion of Kupreanof Island.

Wildlife: Effects of Alternative 4 on wildlife habitat would be intermediate between Alternatives 2 and 3, and slightly less than for Alternative 5. Suitable habitat would decline 4.7 percent for marten and 3.6 percent for black bear. Marginal habitat would decrease for marten (3.3 percent) and Sitka black-tailed deer (4.6 percent), but increase for black bear (2.8 percent). Declines in predicted carrying capacity would be intermediate for all three species. As for all alternatives, river otter and bald eagle habitat would be unaffected.

Fish: Effects to stream habitat conditions would be intermediate between Alternatives 2 and 3. There would be 3.06 miles of Class III streams occurring within harvest units, and there would be 22 road crossings of Class I and Class II streams and 57 crossings of Class III streams. Under this alternative, 296 acres would be harvested in the Castle River watershed and 425 acres in the Tunehean Creek watershed, which have the potential for temperature sensitivity problems.

Biodiversity and Old-Growth: This alternative would harvest an intermediate amount of old-growth forest habitat, estimated at 1,627 acres.

Watersheds: Alternative 4 would be intermediate in effects between Alternatives 2 and 3 and would be similar to Alternative 5. An average of 2.1 percent of watershed area would be harvested.

Soils: Harvested areas with high potential for mass movement is estimated at 406 acres. Mitigation to address this potential hazard includes partial suspension yarding and full bench road construction and endhauling.

Subsistence: A significant restriction of subsistence use of deer is anticipated with this and all action alternatives, primarily due to increased competition for deer resulting from increased access and secondarily due to a decrease in abundance of deer. No other subsistence resources are expected to be significantly affected.

Cultural Resources: Potential impacts to unknown cultural resource sites would be less than Alternative 2, greater than Alternative 3, and similar to Alternative 5.

Recreation: This alternative would have similar acreage in the primitive category as Alternatives 2 and 5 (16,829 acres). Roaded modified acres (23,858 acres) would be less than Alternative 2, greater than Alternative 3, and similar to Alternative 5.

Wild and Scenic Rivers: No harvest units or roads would be located within one quarter mile of any river eligible for Wild and Scenic River designation.

Visual Resources: From the Tebenkof plane route, 599 acres of harvest units are seen in the middleground distance zone and 262 acres in the background. All units meet the inventoried VQOs. Green tree retention is proposed for Unit 36 meeting an inventory VQO of modification.

Economics: The timber value estimated from the mid market analysis would be $ -170/MBF. This analysis is for comparative purposes and does not represent the estimated total value ($ -6.4 million) of the alternative. Of all the action alternatives, Alternative 4 ranks third in terms of estimated economic feasibility per MBF. Indirect effects would be the creation of 333 jobs.

Units Over 100 Acres

Four units ranging in size from 102 to 177 acres are included in Alternative 4 (Table 2-4).

Alternative 5

This alternative was designed to maximize timber volume and minimize road construction to achieve the most economically viable alternative without placing roads or harvest units within the river corridor of eligible wild and scenic study rivers. Harvest units are located in the upper reaches of the Castle River drainage but are outside of the river corridor.

Implementation of this alternative would schedule harvest of 1,948 acres in 31 units for approximately 39.2 MMBF of net sawlog volume (Table 2-7). To implement this alternative, 39 miles of road would be constructed (Table 2-3). Figure 2-5 at the end of Chapter 2 shows the spatial relationship between roads, units, and other geographic features of the Shamrock area.

Guidelines used in selecting units and roads that are consistent with the theme of minimizing cost while staying outside of the Wild and Scenic corridor are provided below.

- Reduce the spatial distance between harvest units in the upper reaches of the Castle River drainage to reduce road costs per timber volume harvested,
- Eliminate potential roads and harvest units where the road mileage to volume ratio is less than 1.0, and
- Exclude the quarter mile corridor of rivers eligible for Wild and Scenic status from timber harvest and road construction.

Table 2-7
Proposed Timber Harvest for Alternative 5 by VCU and Logging Method

VCU	Estimated Volume (MBF)	Highlead (acres)	Skyline (acres)	Shovel (acres)	Helicopter (acres)	Total (acres)
429	20,353	917	170	26	0	1,113
436	11,493	376	30	49	62	517
438	7,332	173	195	200	0	568
Total	**39,178**	**1,466**	**395**	**88**	**62**	**1,948**
Percent of Total		75.2%	20.3%	4.5%	3.2%	100.0%

Issues associated with this alternative include:

Transportation: This alternative provides similar access to new areas as Alternative 4, with construction of 34 miles of permanent road that increases roaded density to 0.21 miles per square mile of land area. There were no unique or substantial resource impacts of this road segment identified during the evaluation of Alternatives 2 and 4.

Wildlife: Effects of Alternative 5 on wildlife habitat would be slightly greater than Alternative 4 and intermediate between Alternatives 2 and 3. There would be declines of 4 and 5.4 percent in suitable habitat for marten and black bear respectively. Marginal habitat would decline 3.6 and 4.6 percent for marten and Sitka black-tailed deer respectively with an increase of 3.2 percent in marginal black bear habitat. Predicted carrying capacities would decrease an intermediate amount for all three species. River otter and bald eagle habitat would be unaffected by this or any alternative.

Fish: Potential effects of Alternative 5 to stream habitat conditions would be intermediate between Alternatives 2 and 3, and similar to Alternative 4. There would be 2.49 miles of Class III streams occurring within harvest units and there would be 18 road crossings of Class I and Class II streams and 53 crossings of Class III streams. Under this alternative 579 acres would be harvested in the Castle River watershed and 390 acres in the Tunehean Creek watershed which have the potential for temperature sensitivity problems.

Biodiversity and Old-Growth: This alternative would harvest an intermediate amount of old-growth forest habitat, estimated at 1,809 acres.

Watersheds: Alternative 5 would be intermediate in effects between Alternatives 2 and 3 and would be slightly higher than Alternative 4. An average of 2.5 percent of watershed area would be harvested. This alternative had the second highest area (2.8 percent) proposed for harvest in the Castle River watershed.

Soils: Harvested areas with high potential for mass movement is estimated at 393 acres. Mitigation to address this potential hazard includes partial suspension, yarding, and full bench road construction and endhauling.

Subsistence: A significant restriction of subsistence use of deer is anticipated with this and all action alternatives, primarily due to increased competition for deer resulting from increased access and secondarily due to a decrease in abundance of deer. No other subsistence resources are expected to be significantly affected.

Cultural Resources: Potential impacts to unknown cultural resource sites would be less than Alternative 2, greater than Alternative 3, and similar to Alternative 4.

Recreation: This alternative would have similar amounts of acreages in the primitive category as Alternatives 2 and 4 (16,829 acres). Roaded modified acres (23,789 acres) would be less than Alternative 2, greater than Alternative 3, and similar to Alternative 4.

Wild and Scenic Rivers: No harvest units or roads would be located within one quarter mile of any river eligible for Wild and Scenic River designation.

Visual Resources: From the Tebenkof plane route, 752 acres are seen in the middleground and 415 acres in the background. All units meet the inventoried VQOs. Green tree retention is proposed in several harvest units as mitigation.

Economics: The timber value estimated from the mid market analysis would be $ -149/MBF. This analysis is for comparative purposes and does not represent the estimated total value ($ -6.4 million) of the alternative. Of all the action alternatives, Alternative 5 ranks second to Alternative 2 in terms of economic feasibility based on net value per MBF. Indirect effects would be the creation of 383 jobs, second to Alternative 2.

Units Over 100 Acres

Five units ranging in size from 102 to 177 acres are included in Alternative 5 (Table 2-4).

Alternatives Summary

The summary in Table 2-8 shows the principal elements of each alternative including volume and acres harvested and miles of new road construction. Each alternative summary includes the number of acres by proposed logging system and the number of harvest units exceeding 100 acres. How each alternative responds to the timber harvest economics issue is displayed.

Each alternative varies in its respective effects on resources. Table 2-9 summarizes the effects of each alternative for the issues identified in Chapter 1. The principal issues are stream habitat conditions for fish, wildlife habitat, Wild and Scenic Rivers, recreation, visual quality, access to new areas, wetlands and watersheds, and biodiversity and old-growth. Subsistence and cultural resource effects were estimated to be minimal for all alternatives and are not listed in this summary.

Table 2-8
Shamrock Alternative Summary

Element of Proposal	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
TIMBER HARVEST					
Total Volume (MMBF)					
Net Sawlog	0	55	22	34	39
Net Sawlog with Utility	0	62	25	38	44
Area Harvested:					
Acres Proposed	0	2,702	1,176	1,766	1,948
Percent Suitable Acres Proposed (out of 25,586 acres)	0	11	5	7	8
Area Harvested by Cutting Method:					
Acres proposed for Clearcutting	0	2,542	1,163	1,681	1,849
Acres proposed for Partial Cutting	0	158	13	85	95
Area Harvested by Logging System:					
Acres proposed for Shovel	0	131	87	87	88
Acres proposed for Highlead	0	1,705	837	1,349	1,466
Acres proposed for Skyline	0	547	252	300	419
Acres proposed for Helicopter	0	342	0	0	0
Units Over 100 Acres	0	7	2	4	5
ROAD CONSTRUCTION					
Miles of specified road construction	0	42	25	34	34
Miles of spur road construction	0	6	3	6	5
Miles of Road 6314 constructed	0	15	8	15	14
ECONOMICS					
Estimated Net Value ($/MBF)	NA	$-144	$-190	$-170	$-149
Estimated Total Value ($million)	NA	$-8.7	$-4.7	$-6.4	$-6.4
Number of Jobs Generated	NA	538	217	333	383
Regional Income Generated ($million)	NA	$17.9	$7.3	$11.1	$12.8
Income Contribution to GNP ($million)	NA	$34.2	$13.8	$21.2	$24.4

Table 2-9
Comparison of Environmental Consequences by Alternative

Element of Proposal	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
WATER QUALITY/FISH HABITAT					
Miles of TTRA buffer along Class I and II streams					
One side of stream	0	3.1	2.0	1.7	2.4
Both sides of stream	0	0.5	0.2	0.2	0.2
Miles of Class III streams affected this entry	0	3.9	1.9	3.1	2.5
Road crossings of Class I and Class II streams	0	24	16	22	18
Road crossings of Class III streams	0	82	47	57	53
WILDLIFE HABITAT					
Acres of "good" habitat for marten	12,756	11,796	12,413	12,136	12,049
Acres of "average" habitat for marten	29,941	28,366	29,267	28,946	28,859
Acres of "good" habitat for Sitka black-tailed deer	0	0	0	0	0
Acres of "average" habitat for Sitka black-tailed deer	8,947	8,443	8,768	8,520	8,522
Acres of "good" habitat for black bear	43,450	40,915	42,431	41,833	41,660
Acres of "average" habitat for black bear	51,334	53,471	52,138	52,616	52,800
WILDLIFE MANAGEMENT INDICATOR SPECIES POPULATIONS (Number of Animals)					
Predicted carrying capacity for marten	251	242	248	245	245
Predicted carrying capacity for Sitka black-tailed deer	2,104	2,041	2,076	2,059	2,056
Predicted carrying capacity for black bear	170	169	170	169	169
WILD AND SCENIC RIVERS AND STREAMS					
Miles of eligible river affected	0	5	0	0	0
RECREATIONAL OPPORTUNITY SPECTRUM (ROS)					
Acres of Primitive	82,622	16,829	46,803	16,829	16,829
Acres of Semi-Primitive Non-motorized	9,468	51,501	33,670	56,833	56,902
Acres of Semi-Primitive Motorized	4,299	4,299	4,299	4,299	4,299
Acres of Roaded Modified	5,430	29,190	17,047	23,858	23,789
VISUAL RESOURCE					
Harvested acres seen in the middleground:					
from Duncan Canal	0	0	0	0	0
from Tebenkof small plane route	0	1,344	32	599	752
Harvested acres seen in the background:					
from Duncan Canal	0	192	0	0	0
from Tebenkof small plane route	0	490	269	262	415

Table 2-9 (cont.)
Comparison of Environmental Consequences by Alternative

Element of Proposal	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
WETLANDS					
Acres of wetland within harvest units	0	309	140	202	204
SOILS					
Harvest acres of high soil hazard	0	676	294	406	393
BIODIVERSITY/OLD-GROWTH					
Acres of old-growth forest harvested (some harvested areas not classified as old-growth)	0	2,537	1,071	1,627	1,809
Acres harvested in Castle River and Tunehean Creek watersheds	0	1,611	144	721	969
WATERSHEDS					
Average percent of watershed area harvested	0	3.2	1.6	2.1	2.5
Acres harvested in Castle River and Tunehean Creek watersheds	0	1,611	144	721	969
Road miles proposed in Castle River and Tunehean Creek watersheds	0	21.6	3.4	13.4	15.8

Mitigation

The following mitigative measures would be required for implementing a timber harvest for the Shamrock area. The mitigative measures are applicable for all action alternatives. These measures represent current understanding of how best to mitigate impacts of timber harvesting and road construction on biological, aesthetic, and cultural resources. The effectiveness of these and other mitigation measures are continually evaluated based on such programs as the Stikine Area Soil/Water Quality/Fisheries Monitoring Program, which was developed with the help of the Alaska Department of Environmental Conservation and assesses both mitigation implementation and effectiveness. In some cases mitigation measures are well established and have been used for decades, while other measures are relatively new and somewhat experimental, such as some of the New Forestry techniques. The monitoring program described below is part of an on-going program to evaluate the effectiveness of a broad range of mitigation measures, both old and new.

- If cultural sites are discovered once the sale is in operation, protective measures will be taken under the Timber Sale Contract.

- Pursuant to the Tongass Timber Reform Act of 1990, commercial timber harvesting would be prohibited within a buffer zone no less than one hundred feet in width on each side of all Class I streams and those Class II streams which flow directly into a Class I stream. To protect downstream water quality, other Class II and all Class III streams would receive protection through a combination of directional felling of trees, partial suspension of logs, split-yarding, and removal of logging debris from stream channels.

- Full bench construction and end hauling of excavated material would be required on designated areas for soil stability and to prevent sedimentation from entering streams (see Road Descriptions, Appendix A-2).

- Group selection, green tree retention, and snag retention would be implemented where feasible to help maintain wildlife habitat, structural diversity, biodiversity, and visual quality (see Unit Descriptions, Appendix A-1).

- After use temporary roads would be closed, water bars added at appropriate places, and drainage structures removed.

- Timing restrictions on in-stream road construction work would be implemented when and where appropriate during critical periods to protect fishery resources (see Road Descriptions, Appendix A-2).

- Stream crossings of Class I and II streams would be constructed to allow continued fish passage.

- Partial suspension during log yarding would be required in designated harvest units to reduce soil disturbance, thus maintaining soil productivity and minimizing soil transport to streams (see Unit Descriptions, Appendix A-1).

- Bridges would be installed at designated stream crossings to minimize the amount to sediment entering stream channels (see Road Descriptions, Appendix A-2).

Monitoring

Monitoring would be conducted to determine if resource management objectives of the Shamrock harvest have been met. Monitoring results would be used to verify implementation and effectiveness of selected mitigative and protective measures in a timely manner. The following three types of monitoring were recognized in the development of the monitoring plan and are described below.

Implementation Monitoring

Sale Planning: Implementation monitoring assesses whether or not the project was implemented as designed and in compliance with the Forest Plan. Planning for implementation monitoring began with the design of this timber harvest. Specialists used on-the-ground inventories, computer inventories, and aerial photographs to prepare documents called unit design cards for each harvest unit. Road design cards were also prepared for each road segment. Resource specialists wrote their concerns on the cards and then described how the concerns could be addressed in the design of each unit and road segment. These documents would be the basis for determining whether recommendations were implemented for various aspects of this project.

Sale Preparation: The next step in this process involves incorporating the mitigative measures described in this EIS and ROD into the timber sale preparation and road design. Forest Service personnel experienced in sale preparation and road design would prepare a timber sale contract that reflects the measures prescribed by the ID Team. During this phase, minor changes may be made to units and roads to reflect the intent of the mitigative measures presented in this EIS. This preparation step would involve a "plan-in-hand" review of the timber sale to ensure that planned project elements have been incorporated into the timber sale contract and road plans.

Sale Administration: Implementation monitoring continues through harvest and contract inspections by trained sale administrators and road inspectors as a routine part of project implementation. Through provisions contained in the timber sale contract, the sale and road administration process assures that the prescriptions contained on the unit and road cards are implemented. Sale administrators and contract inspectors have the authority to initiate remedial action to repair resource damage and suspend operations until problems have been corrected. This process ensures that project elements are implemented as designed and that standards and guidelines are followed to protect soil productivity, water quality, fish habitat, and other resources.

Best Management Practices: BMP's are designed to directly or indirectly protect water quality, and minimize any adverse impacts on water quality that are associated with a land disturbing activity, such as timber harvest or road construction. For this project, monitoring would focus on timber and transportation-related activities. BMP implementation monitoring forms have been developed and are designed to be tailored to each site under consideration. BMP's to be monitored at a specific site are determined through a review of unit and road cards, fish habitat reports, and other appropriate documentation.

All roads and units completed in the Shamrock Timber Sale area will be considered for BMP implementation monitoring sites. Sites are selected randomly using a stratified process that emphasizes units and roads with water quality and fish habitat concerns. However, if a unit or road has special resource concerns, it may be monitored in addition to the randomly selected sites. Monitoring is conducted according to methods described in the Stikine Area 1994 Soils/Water Quality/Fisheries Monitoring Report. The current goal is to monitor ten percent of all roads and units completed each fiscal year.

Pre-harvest issues of concern include land disturbing activities on high hazard soils (BMPs 13.2,1 13.5, 13.16), road and landing locations (BMPs 13.10, 14.3, 14.6 through 14.10 and others) and channel stability and streamside management, including stream temperature sensitivity (BMPs 12.6, 13.9, 13.16).

Effectiveness Monitoring

Effectiveness monitoring seeks answers about the effectiveness of design features or measures in protecting natural resources and their beneficial uses. The Tongass National Forest completed an effectiveness monitoring strategy in 1994 (4/22/94) which establishes monitoring priorities related to water quality and fish habitat. Riparian buffer stability and fish passage through culverts were both identified as monitoring priorities and both may be monitored in the Shamrock Timber Sale area. The Stikine Area Soil/Water Quality/Fisheries Monitoring Program (5/2/94) contains monitoring plans for buffer stability and fish passage. Petersburg fisheries and watershed staff are currently revising both monitoring plans based on 1994 monitoring

results. The following displays the effectiveness monitoring that would be performed following implementation of an action alternative:

Timber Restocking

Objective:	Ensure restocking occurs within minimum time frames stated in the NFMA.
Desired Result:	Adequately restocked timber stands.
Measurement:	Stocking surveys within the first five years.
Evaluation:	Determine that stocking is adequate. Prescribe planting if natural regeneration is inadequate.
Responsible Staff:	District silviculturist.

Muskeg lowland on Kupreanof Island

Residual Trees (within units)

Objective:	Determine the effectiveness of the different leave tree configurations in maintaining windfirm trees.
Desired Results:	Trees selected for retention remain standing
Measurement:	Document the number of residual trees that remain standing at one, five, and ten years following harvest.
Evaluation:	Evaluate the effectiveness of windfirmness of different leave tree configurations.
Responsible Staff:	District Silviculturist

Validation Monitoring

Validation monitoring is conducted to check on assumptions made about resource effects. It is usually carried out at the regional level. The only validation monitoring planned at this time for the Shamrock timber sale is for cultural resources.

Cultural Resources

Objective:	Validate assumptions of cultural resources probability model.
Desired Result:	No impact to cultural resources.
Measurement:	On the ground observation of ground disturbance (e.g., road cuts).
Evaluation:	Validate assumptions of cultural resources probability model.
Responsible Staff:	Forest Archeologist.

Figure 2-1 Shamrock Harvest Plan, Alternative 1

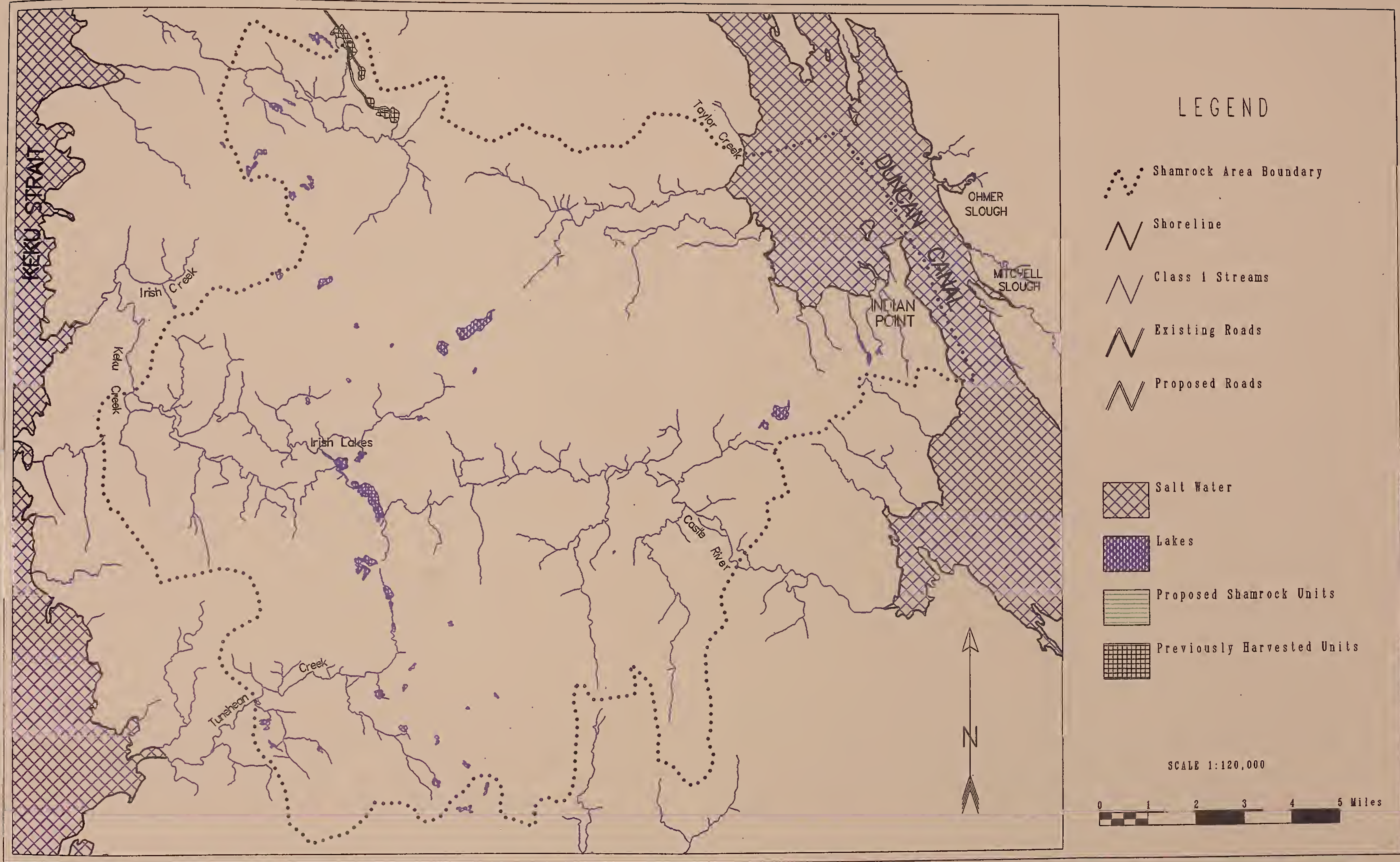


Figure 2-2 Shamrock Harvest Plan, Alternative 2

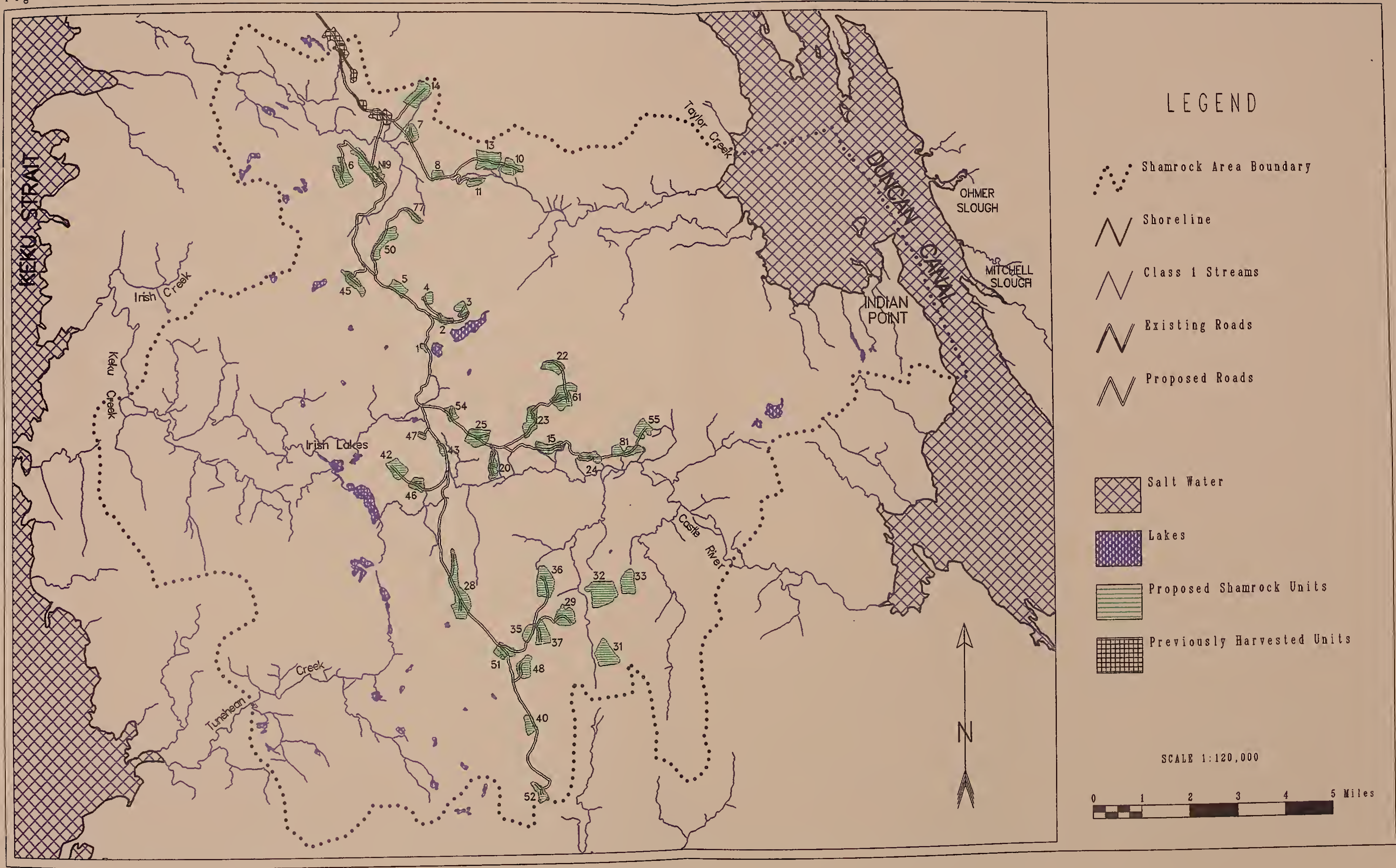


Figure 2-3 Shamrock Harvest Plan, Alternative 3

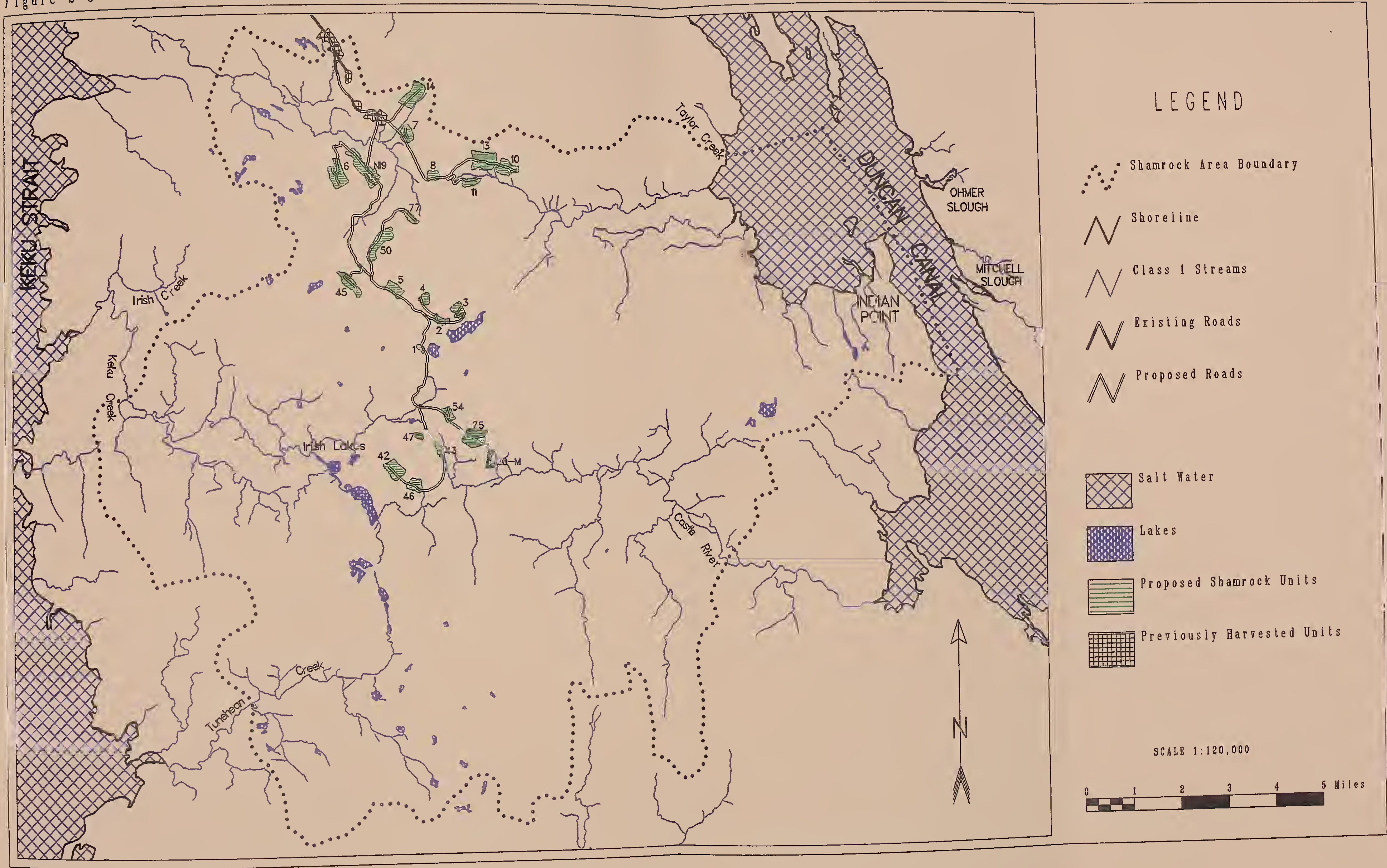


Figure 2-4 Shamrock Harvest Plan, Alternative 4

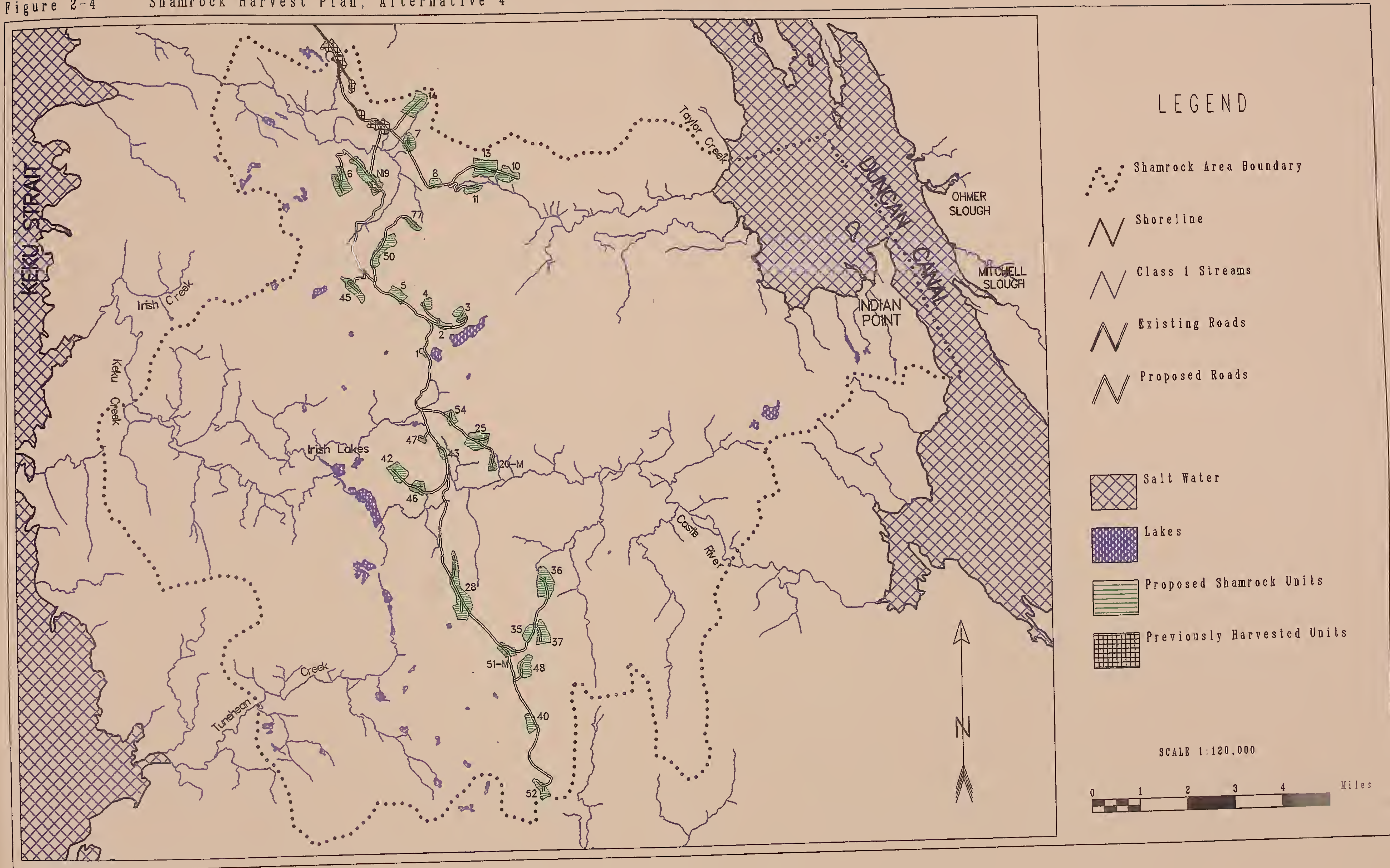
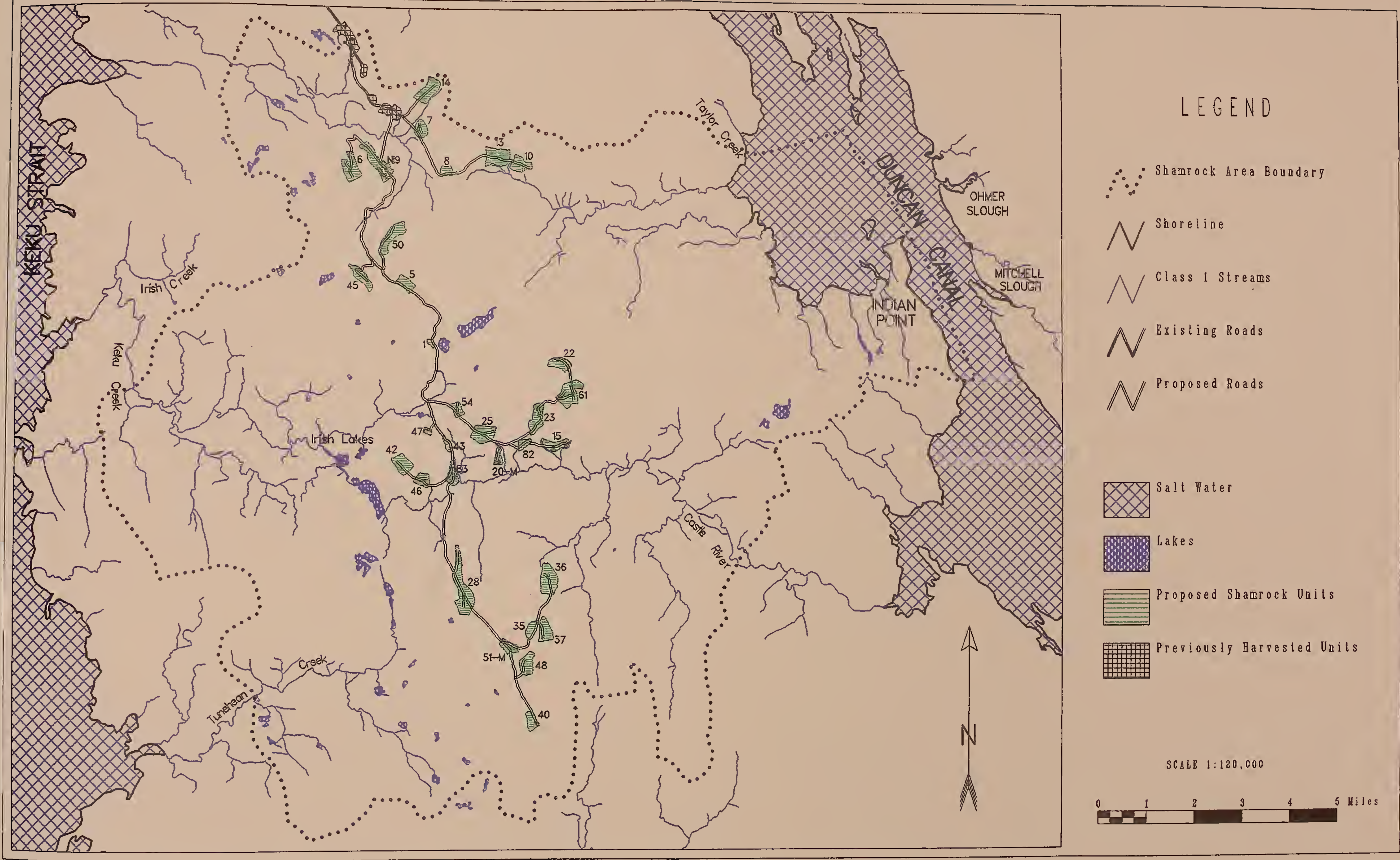


Figure 2-5 Shamrock Harvest Plan, Alternative 5



Chapter 3

Affected Environment

Chapter 3

Affected Environment

Introduction

This chapter describes the portions of the physical, biological, cultural and social environment that may be affected by implementation of any of the alternatives. The description focuses on resource conditions in the area potentially affected by the alternatives. Some resource conditions consider a larger area if potential effects extend beyond the analysis area. This description of current conditions provides the basis for assessing the environmental effects of alternatives discussed in Chapter 4. It also provides the context for assessing how the alternatives respond to the issues identified in Chapter 1.

Transportation

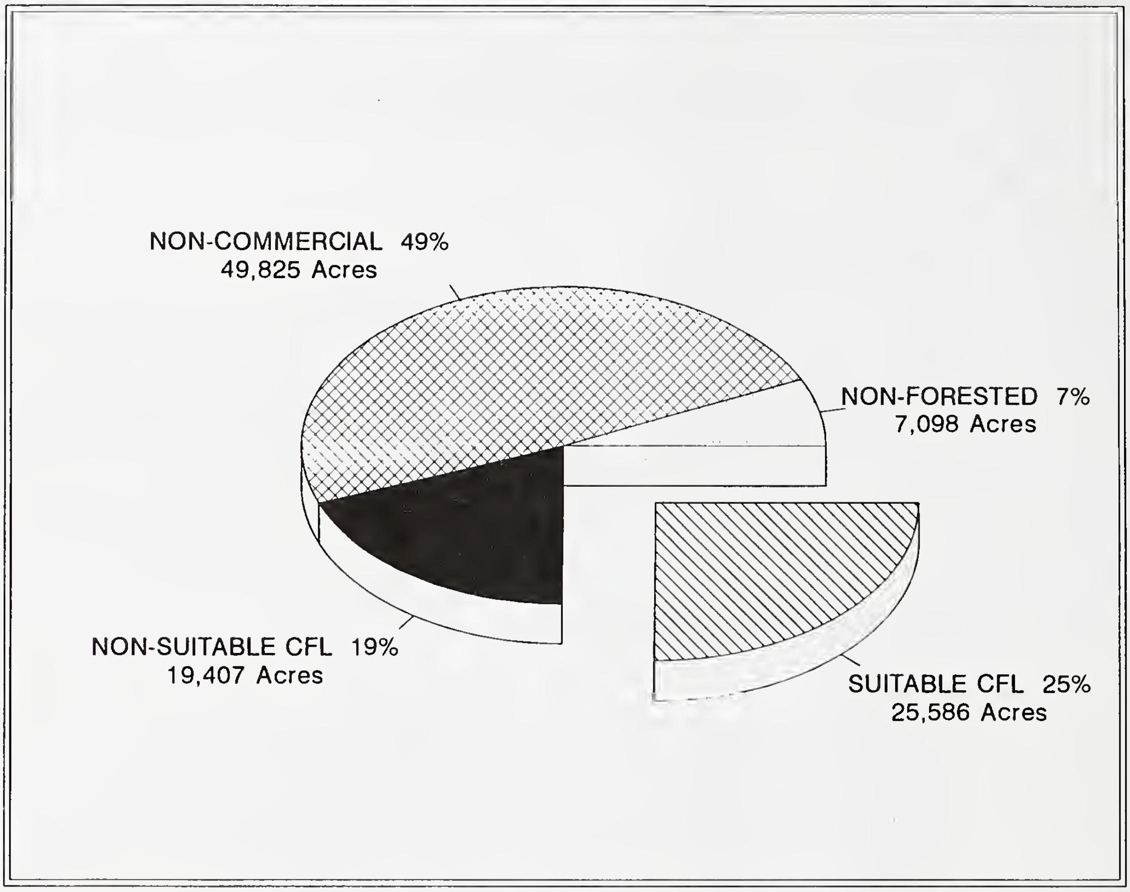
The Shamrock area is primarily unroaded except in the northern part where two miles have been constructed for the North Irish timber sale. The existing road system provides direct access to the village of Kake (estimated population of 700), located on the northwest end of Kupreanof Island, facing Keku Strait. Both float and wheeled air taxis make scheduled trips to Kake. The Alaska Marine Highway ferry provides twice-weekly landings in Kake, southbound to Petersburg, and northbound to Angoon and Sitka.

The Little Hamilton log transfer facility (LTF) provides access to saltwater for timber proposed to be harvested from the Shamrock area. In 1983 this facility was reconstructed to a concrete pile supported dock facility, designed for A-frame or crane lift. This design provides a controlled, non-violent entry of logs into the salt water. This LTF covers 1.42 acres of land area and 0.31 acres of estuarine area (Faris and Vaughan, 1985). The current permits for this LTF are valid until the year 2017.

Vegetation

The Shamrock area covers 94,818 acres of forested lands in the coastal temperate rain forest of Southeast Alaska. Of the forested lands, 44,993 acres are commercial and 49,825 acres are non-commercial. To be considered commercial forest land, an area must be capable of producing 20 cubic feet per acre per year or have a site index of 40 or more. Of the commercial land, 19,407 acres are not considered suitable for timber production due to high potential erosion and slope failure, or due to their removal from consideration by statute or administrative action. Commercial forest land considered suitable for timber production covers 25,586 acres (Figure 3-1).

Figure 3-1
Shamrock Area Land Base



Source: Seaberg, 1993.

The Timber Resource

The Shamrock area contains large expanses of non-commercial land on poorly drained, low-productivity sites that cannot sustain commercial timber volume. Higher volume commercial forest stands generally are located on the better drained sites along streams and on the steeper mountain slopes. Lower volume commercial stands occur on the poorly-drained sites and at the highest elevations. Site index and volume class are the chief measures of site productivity.

Habitat inventory in the Shamrock area

windthrow. Seedling/sapling stands with less than 8 thousand board feet (MBF) per acre represent Volume Class 2, and pole timber stands less than 8 MBF per acre represent Volume Class 3. Volume Classes 4 through 7 contain trees of merchantable size timber with more than 8 MBF per acre. Of the 44,993 acres of commercial forest land in the Shamrock area, 44,377 acres are in Volume Classes 4 through 7 (Table 3-1).

Timber Species Distribution

Commercial forest species in the Shamrock area include Sitka spruce, western hemlock, Alaska-cedar and mountain hemlock. Non-commercial species include shore pine and alder. Species composition within the Shamrock area that is being

Table 3-1
Shamrock Area Volume Class Distribution by Acres

Volume Class	Board Feet Per Acre	Commercial Forest Land Acres (%)	Suitable CFL Acres (%)
4	8-20,000	25,842 (58)	12,826 (50)
5	20-30,000	15,136 (34)	10,551 (41)
6	30-40,000	3,184 (7)	2,058 (8)
7	50,000+	215 (1)	151 (1)
Total		44,377 (100)	25,586 (100)

Source: Seaberg, 1993

considered for harvest consists of 77 percent western hemlock, 14 percent Sitka spruce, 1 percent mountain hemlock, and 8 percent Alaska-cedar. Product quality is variable with a large portion of the available volume suitable only for pulp wood. There are, however, some areas with large-diameter trees, which provide a source for high quality hemlock, spruce and Alaska-cedar sawlogs.

Age Distribution

The commercial forest stands in the Shamrock area are predominantly uneven-aged and overmature. These stands contain trees of many ages, sizes and conditions, with dead trees comprising a significant portion. Overmature stands have reached an equilibrium in productivity where annual growth is offset by mortality so that net growth is zero. A minor component of the commercial forest exists as various even-aged stands which originated from windthrow or timber harvest. These stands are more uniform in size and have fewer dead trees.

Windthrow Hazard

Windthrow or wind damage is the principal disturbing agent in the Southeast Alaska forest ecosystem. Each year high winds sweep through forests and at times cause considerable damage. Openings created by wind provide the major natural event in the formation of new timber stands. Consideration of windthrow is important in the planning and design of timber harvests because the created openings in the landscape make adjacent timber stands become more susceptible to windthrow. In the areas considered for timber harvest, wind damage is more likely in areas directly exposed to south and southeast winds and having the highest timber stand densities. Windthrow hazard in the Shamrock area where units were sampled consists of 24 percent with a high risk rating, 63 percent medium risk ratings, and 13 percent low risk rating (Seaberg, 1993).

Hemlock forest in the Shamrock area

Insects and Disease

The old-growth stands are declining in productivity, and wood defect and decay is estimated to be as high as 27 percent of the volume. Dwarf mistletoe, a parasite that inhibits growth, is present in all harvest units sampled and was considered significant in 67 percent of these units. Alaska-cedar decline in the Shamrock area is primarily confined to wet, boggy areas which occur outside areas considered for timber harvesting.

Past Harvest

In 1990 approximately 157 acres were harvested in the North Irish timber sale. These areas have been surveyed and are certified as restocked.

Hardhock (Spiraea douglasii) reaches the northern extent of its range in the Shamrock area

Threatened, Endangered, and Sensitive Plant Species

No federally recognized threatened or endangered plant species occur in Southeast Alaska. Two Category 2 species are known for the region: Thurber's reedgrass (*Calamagrostis crassiglumis*) and a sedge (*Carex lenticularis* var. *dolia*) (Category 2 species are those that are candidates for listing, but more information is needed before a determination can be made). There are no plant species officially recognized by the State as threatened, endangered, or sensitive (TES) in the Shamrock area. The Forest Service published a list of sensitive species for the Alaska Region that included 22 plant species (Table 3-2). Of these 22 species, 18 were considered potentially occurring in the Shamrock area. In addition to the Forest Service Sensitive Species List and Federal candidate species for listing, the ANHP rates species according to their rareness (ANHP, 1990). Review of species considered rare by the ANHP indicated that four additional species should be included in surveys for TES plant species. These species included Indian paintbrush (*Castilleja chrymactis*), typically found in meadow habitats; bog clubmoss (*Lycopodium inundatum*), occurring in bogs and wet shorelines in extreme Southeastern Alaska; tufted loosestrife (*Lysimachia thyrsiflora*), found along shorelines of streams, lakes, and ponds; and Menzies' spiraea (*Spiraea douglasii* subsp. *menziesii*), occurring in wet areas of swamps, bogs, lakeshores, and streambanks.

Table 3-2
Sensitive Plant Species List - Alaska Region - USDA Forest Service

Common Name	Scientific Name	Habitat// Range[1]
*(no common name)	*Aphragmus escholtzianus*	tundra and heath, often in wet areas// ranging from Seward Peninsula and Aleutians to southern AK and southwestern Yukon
*Norberg arnica	*Arnica lessingii* ssp. *norbergii*	alpine and subalpine meadows, arctic and alpine tundra, heath, open woods// endemic to southern AK; known occurrence in Tongass Nat. Forest, Juneau Dist.
*Goose-grass sedge	*Carex lenticularis* var. *dolia*	wet meadows and lake shores, snowbeds above 600 meters// limited to alpine of coastal Southcentral and SE AK; known occurrence in Tongass Nat. Forest, Juneau District
*Edible thistle	*Cirsium edule*	wet meadows, woods, forest edges, along glacial streams// endemic in southern SE Alaska
*Pretty shooting star	*Dodecatheon pulchellum* ssp. *alaskanum*	saline meadows along the sea// limited to Southcentral and Southeast coasts of AK; known occurrence in Tongass Nat. Forest, Juneau Dist.
*Northern rockcress	*Draba borealis* var. *maxima*	alpine tundra, heath, open woods, often on rock outcrops// limited to Kodiak, Southcentral and northern Southeast AK; known occurrence in Tongass Nat. Forest, Juneau District
Kamchatka rockcress	*Draba kamtschatica*	rocky alpine// limited to Southcentral AK; to be expected in Southeast, Seward Peninsula, and Aleutians
Tundra whitlow-grass	*Draba kananaskis*	rocky alpine slopes// single occurrence in the state in Chugach Nat. Forest
*Davy mannagrass	*Glyceria leptostachya*	shallow freshwater, stream and lake margins// regional endemic, Wrangell area in SE Alaska; documented occurrences in Tongass Nat. Forest
*Wright filmy fern	*Hymenophyllum wrightii*	humid shaded rocks, bases of trees, decaying wood, also *Mecodium wrightii* rootwads, among moss, in the wettest maritime regions - dense humid coastal forests near saltwater// gametophytes known from the Petersburg and Sitka areas; observed on Biorka and Mitkof Islands
*Truncate quillwort	*Isoetes truncata*	shallow water pools or ponds// Prince William Sound to Kodiak, disjunct from Vancouver Is., to be expected in area between; possible occurrences on USFS lands

Table 3-2 (cont)
Sensitive Plant Species List - Alaska Region - USDA Forest Service

Common Name	Scientific Name	Habitat// Range
*Calder lovage	*Ligusticum calderi*	alpine/subalpine meadows, open boggy or rocky slopes, rocky cliffs// regional endemic, known from Vancouver Is. through southern SE Alaska (Dall Island), and Kodiak Is., to be expected elsewhere in the Tongass or Chugach Nat. Forests
Pale poppy	*Papaver alboroseum*	open areas, rock outcrops, sandy, gravelly, well drained soils// Kamchatka and northern Kurile Islands, disjunct to Cook Inlet, Kenai Peninsula, Portage Glacier, disjunct to northern B.C. and southern Yukon, known from Cook Inlet, Wrangell Mountains, and western Alaska Range
*Choris bog orchid	*Platanthera chorisiana*	mossy upper beach meadows, swamps, muskegs, heaths from near sea level to 500 feet// scattered from Aleutian Is., Prince William Sound, Southeastern AK; documented occurrences in Tongass Nat. Forest
*Bog orchid	*Platanthera gracilis*	wet meadows// limited to southernmost SE AK; documented in Tongass Nat. Forest
*Loose-flowered blue-grass	*Poa laxiflora*	lowland wooded areas in moist shade along upper margins of sea beaches and in open-forested meadows along riverbanks// known only from Cape Fox on east shore of Revillagigedo Channel and at a hot spring in the Behm Canal area of SE Alaska.
Smooth alkali grass	*Puccinellia glabra*	wet places including sea beaches, tidal flats, and salt marshes// limited to Cook Inlet, Kenai Peninsula, and Kodiak Is.; documented from Chugach Nat. Forest
*Kamchatka alkali grass	*Puccinellia kamtschatica*	wet places, sea beaches// occurrences documented in Tongass Nat. Forest, Juneau District; limited to Southcentral and Southeast AK
*Straight-beak buttercup	*Ranunculus orthorhynchus* var. *alaschensis*	meadows, forests, moist open sites// documented in Tongass Nat. Forest; limited to southern SE AK
*Unalaska mist-maid	*Romanzoffia unalaschcensis*	cracks in rock outcrops, along streambanks, beach terraces, open rocky areas// endemic to Aleutians, Alaska Peninsula, Kodiak and scattered locations east to Sitka; to be expected elsewhere in southern AK

Table 3-2 (cont)

Sensitive Plant Species List - Alaska Region - USDA Forest Service

Common Name	Scientific Name	Habitat// Range
*Queen Charlotte butterweed	*Senecio moresbiensis*	alpine and subalpine meadows, shady wet boggy areas, boggy or rocky slopes, open rocky heaths or grassy areas// endemic to southern SE AK, limited to Coronation, Prince of Wales, and Dall Islands in SE AK, documented in Tongass Nat. Forest
*Circumpolar starwort	*Stellaria ruscifolia* ssp. *aleutica*	gravelly sites along creeks in the mountains// limited to Coastal SE and Southcentral AK and Aleutians

1 Habitat and range are as described in Hulten's *Flora of Alaska and Neighboring Territories* (Hulten, 1968) and Anderson's *Flora of Alaska and Adjacent Parts of Canada* (Welsh, 1974).

2 Sensitive species potentially occurring in the Shamrock area are marked with an "*."

A total of 109 plant species were recorded during the field surveys of forest, riparian, muskeg, subalpine, and estuarine-beach habitats in the Shamrock area (Chapin, 1993b). Neither Category 2 species listed above were observed. However, Menzie's spiraea (*Spiraea douglasii* subsp. *menziesii*) was found at three locations in shoreline habitat typical for this species. This shrub in the rose family is listed by the ANHP as rare in Southeast Alaska. Associated species included sphagnum moss, false azalea, cow parsnip, false hellebore, shore pine, water sedge, and bunchberry. Populations were located along the south shoreline at the northwest end of Irish Lake, in a marshy area between the large and small unnamed lakes (often referred to as Kluane lakes), and in a riparian shrub community along the Castle River.

The Shamrock area is near the northern edge of the geographical distribution of Menzies' spiraea, which ranges from Southeast Alaska to northwestern Oregon and northern Idaho (Hitchcock and Cronquist, 1978). The species has not been thoroughly investigated in Southeast Alaska, and the ANHP has suggested that the plant is probably much more widespread and common than is currently documented. The identification of three populations of Menzies' spiraea in a limited amount of field survey suggests that this species is common in the Shamrock area.

Wetlands

Approximately 65,500 acres were identified as wetland, comprising 61 percent of the Shamrock area. Six wetland types were identified during the investigation: coniferous forest; muskeg; mixed forest-muskeg; estuaries; subalpine and alpine; and lakes, ponds, and associated marshes. Most of the identified wetlands were mixed forest-muskeg wetland; muskeg was the second-most abundant wetland type; and wetlands characterized by other vegetation types were much smaller in area (Table 3-3).

With few exceptions, wetlands are distinguished by the presence of water, unique soils that differ from adjacent upland soils, and vegetation adapted to wet conditions. The frequent occurrence of wetland hydrologic conditions across the Shamrock area is due

Table 3-3
Dominant Wetland Vegetation and Acreage

Wetland Vegetation Type	Typical Species	Acreage
Mixed forest-muskeg	Sitka spruce western hemlock shore pine bog cranberry sphagnum moss	41,033
Coniferous forest	Sitka spruce western hemlock five-leaved bramble rusty menziesia skunk cabbage	4,644
Muskeg	shore pine bog cranberry deer cabbage bunchberry	16,162
Estuaries	seaside plantain sea milkwort Lyngbey's sedge	34
Subalpine/alpine	mountain hemlock deer cabbage sedges caltha-leaf avens	3,094
Lakes, ponds, and associated marshes	dwarf water lily yellow pond lily manna grass sedges	569

Source: Zemke and Chapin, 1992a

primarily to the abundant precipitation in the region combined with lack of topographic relief, shallow depth to bedrock or compact glacial till, and accumulations of peat that impede drainage. Twenty-eight of the 131 soil types mapped by the Forest Service (USDA Forest Service, 1991b) in the Shamrock area are classified as hydric soils. These organic soils or mineral soils with relatively high organic material content are consistently found in the Shamrock area wetlands.

Wetland Functions

Wetlands in general are recognized to provide certain functions: floodflow modulation, wildlife habitat, groundwater recharge, groundwater discharge, sediment retention, toxicant reduction, and sustaining streamflows during dry seasons. The wetland types identified in the Shamrock area vary in their ability to provide recognized wetland functions, but most commonly they provide sediment retention, floodflow alteration, and wildlife habitat.

Sediment retention is the removal of sediment from water. The Shamrock area wetland types most important in sediment retention are muskegs and marshes that are located in stream valleys, particularly below sites prone to mass wasting or landslides. These wetlands are capable of capturing and holding sediments due to their frequent location in low-lying areas and the reduction in stream flow that occurs when water passes through vegetation.

Floodflow modulation is the reduction in magnitude of peak flows and the delay in release of water to downslope areas immediately after storms. The Shamrock area wetland types most important in modulating floodflows are the forested wetlands and muskegs located adjacent to streams and rivers. Muskegs can effectively modulate floodflows because of the storage capacity of organic soils. The organic soils and often dense vegetation of forested wetlands can also impede downslope movement of water and act to modulate peak flows.

Although there is not as sharp a distinction between wetland and non-wetland habitat in Southeast Alaska as there is in more arid regions, some wetland types in the Shamrock area do have unique roles as wildlife habitat. On a per acre basis, the most important wetland areas to wildlife in the region are estuaries, but this habitat is very rare in the Shamrock area. In inland areas, marshes adjacent to bodies of fresh water are of critical importance to a variety of species. Numerous species of amphibians, waterfowl, shore birds and some mammals require open-canopy wetland areas interspersed with small open water areas. River otters and beaver utilize marshes adjacent to open water for both food and cover.

Wildlife

Wildlife fauna increases the biological diversity of the region and provides considerable intrinsic value to the wildlands. Secondary to the natural value of the Alaskan ecosystems, resident and migratory wildlife provide substantial aesthetic, recreational, subsistence, and economic opportunities for the human population. Land management procedures, such as the environmental impact assessment process, are designed to provide a platform for the balancing of wildlife resource requirements with societal needs. The process begins with a basic understanding of the existing resources.

Wildlife Habitats

The appearance of particular wildlife species in a region is dependent upon the presence of habitat suitable to support at least some stages of the species' life-cycle activities (i.e, feeding, reproduction, cover). Wildlife habitats in the Shamrock area (and Southeast Alaska in general) are of three broadly-defined types: aquatic, forested, and non-forested. Specific habitats within each of these generalized categories have been described in Taylor (1979), whose classification scheme is briefly summarized below:

Aquatic - The diverse category of "aquatic habitat" includes marine waters, estuaries, rivers, lakes, and freshwater wetlands, and associated fringe habitat, all of which are found in the Shamrock area. The marine ecosystem includes the ocean, bays, and major waterways surrounding Kupreanof Island, and estuaries are formed where freshwater (riverine) outflow from the island enters the sea. For the Shamrock area, these habitats are limited to the shoreline along Duncan Canal, although Frederick Sound, Sumner Strait, and Keku Strait are accessible to wide-ranging mammals and within short flying distance for birds. The interior of Kupreanof Island contains several lakes, and a variety of creeks, streams, rivers, and freshwater wetlands. Included with the aquatic habitat category is the associated fringe habitat. Fringe

habitats are transitional zones between the wholly aquatic habitat and the surrounding terrestrial habitat, and can be well-developed and distinct (e.g., a riparian corridor) or non-distinct (e.g., forest abutting a lake).

Forested - Forested habitat is the predominant wildlife habitat in the Shamrock area. Subsets of this habitat type include: coastal western hemlock and Sitka spruce forest, bottomland spruce and poplar forest, upland spruce and hardwood forest, and lowland spruce or hardwood forest (Taylor, 1979). Within these forest groups, an important component is old-growth forest. Old-growth is characterized by large-diameter trees of advanced age, within-stand decadence (downed trees, snags, etc.), and a well-developed shrub understory. The structural and ecological complexity of old-growth stands are important to a variety of wildlife species, and some wildlife species may be dependent exclusively upon old-growth habitats for some or all of the species' life-cycle needs (e.g., marten, cavity nesting birds, and marbled murrelets).

Non-forested - Within the Shamrock area, the primary non-forested habitats are the muskeg and bog wetlands. Other non-forested habitats (high brush, moist tundra, wet tundra, and alpine tundra) are also included in this designation (Taylor, 1979).

Wildlife Species

Taylor (1979) developed a regional wildlife species inventory for Alaska, and coupled this inventory with the habitat categorizations summarized previously. Amphibian, reptilian, avian, and mammalian species observed during Shamrock wildlife surveys provide more area-specific data on wildlife occurrences (Fendick and Gunther, 1993).

Reptiles and Amphibians

Six species of amphibians and two reptilian species occur in the region. Observations of amphibians during Shamrock EIS field activities were very infrequent, but included rough-skinned newt, boreal toad, and a frog tentatively identified as a wood frog; no reptilian species were seen (or reported by area resource agencies). The population status of amphibian and reptilian species in the Shamrock area is not known.

Birds

Not all of the 277 bird species found in Southeast Alaska would be expected to be observed in the Shamrock area. Many regularly-occurring species prefer habitats that are not present in the Shamrock area, while the relatively brief duration of the summer field surveys excluded a number of regular migrants. In addition, field efforts focused on the terrestrial forested habitats in the Shamrock area, whereas many regularly-occurring species are associated with aquatic habitats.

Overall, 53 species of birds from 23 avian families were directly observed during field surveys of the Shamrock area. Within the forested harvest units, winter wren, western flycatcher, varied thrush, and red-breasted sapsucker were the birds most commonly observed, accounting for over half of the total number of bird detections during songbird surveys in the Shamrock area. Songbird species richness in harvest units where songbird surveys were conducted was somewhat similar among units, ranging from 7 to 13 different species per proposed harvest unit. The similarity in vegetative type in the surveyed harvest units (all sites were in western hemlock forests) is probably a major factor in this overall similarity of species among harvest units.

Wildlife surveys, an important element of the Shamrock EIS

Mammals

Nearly one-third of the 77 mammalian species found in Southeast Alaska are marine whales, dolphins, porpoises, seals, and seal lions and, with a few exceptions, are not likely to occur with any regularity in the Shamrock area. The remaining species that occur in the region include rodents, carnivores, bats, insectivores, shrews, hoofed mammals, and lagomorphs (pika and hares). The specific distribution of terrestrial mammalian species, other than a few of the game mammals, on Kupreanof Island and in the Shamrock area is largely unknown.

Mammal sign was abundant within the Shamrock area, although actual sightings were limited. Direct sightings were restricted to a few bear, one moose with calf, one deer, river otter, beaver, squirrel, and one wolf sighting. Other mammal sign included bear trails and scat, moose scat and tracks, wolf howlings, beaver sign and lodges, porcupine-stripped trees, and river otter holes. Harbor seals were the only marine mammals observed, although they were only seen in the waterways surrounding the perimeter of Kupreanof Island, and not near the shoreline boundaries of the Shamrock area.

Management Analysis Methods

Evaluating the effects of proposed timber harvest in the Shamrock area upon each wildlife species would be an enormous task. To limit the scope of environmental impact evaluations to a reasonable number of wildlife species, several generalized management approaches can be used: Management Indicator Species (MIS); habitat capability models; impact evaluations to threatened, endangered, or sensitive wildlife species; or assessment of other important species. Though differing in their analytical specifics, these four generalized approaches all serve to focus environmental analyses upon those species or factors that are thought to play the most critical roles in a particular ecosystem.

Management Indicator Species

The MIS approach is mandated by the National Forest Management Act, and requires that MIS be identified for the affected forest and that management alternatives be explored with reference to those chosen species. The selection of MIS is based on consideration of the wildlife species present in an analysis area, habitat requirements, the diversity of landforms and vegetative communities, and the capability of wildlife species to adapt to changes in habitat, predation, and other related factors. Another criterion for the Shamrock EIS was the availability of computer-based habitat capability models that could be used to describe existing conditions and predict wildlife impact. The five MIS selected for the Shamrock EIS were Sitka black-tailed deer, marten, black bear, river otter, and bald eagle.

Habitat Capability Models

The occurrence of wildlife in a given area is intimately dependent upon the type(s) of habitat in the region. Wildlife species are dependent upon specific habitat characteristics for feeding, cover, and reproductive activities. When a region contains a sufficient amount of the appropriate habitat types, then particular wildlife species might utilize the region. The habitat requirements of selected wildlife species can be incorporated into resource management decisions through the use of habitat capability models. The utility of habitat models lies in their systematic linkages among habitat features and measurable forest attributes. Such models provide resource managers with a needed capability to quantify aspects of wildlife habitat. There are, however, limitations to habitat capability models. A key concern lies in uncertainty of the relationship between wildlife utilization of specific areas and the generalized assumptions that are incorporated into mathematical modeling of complex biological phenomena. Typically, habitat capability models incorporate the current knowledge of wildlife habitat preferences, but scientific review of habitat models is usually ongoing. Nonetheless, habitat capability models provide a systematic and objective consideration of wildlife resources into planning processes.

As part of the Tongass Forest Plan Revision, habitat capability models were developed to analyze the capacity for the region to support selected MIS based on measurable habitat qualities. However, the models usually do not directly incorporate non-habitat factors, such as predation, disease, or human harvest, that may also affect wildlife populations. These models predict a Habitat Suitability Index (HSI) of the potential for the Forest to support the MIS. Suitability indices are approximations of habitat quality, based on the existing knowledge of wildlife habitat requirements and should not be considered as estimates or measurements of wildlife population sizes. Suitability indices range from 0 to 1, with a HSI=0 indicating that the habitat is not capable of supporting the species, while HSI=1 indicates that the habitat is not limiting the species. Intermediate indices reflect the potential for the habitat to support a proportion of the individuals that could be sustained under optimal habitat conditions. For example, an HSI=0.8 indicates that an area is capable of supporting approximately 80 percent of the population that might be expected in an area of optimal (HSI=1) habitat.

The Shamrock area contains 108,000 acres of potential wildlife habitat, including areas of open water. Particular species will only utilize portions of this total, based upon the species' particular habitat preferences. Habitat capability models apportion suitability indices to the Shamrock area using a computer database describing both the Shamrock area and the MIS habitat preferences. Habitat capability modeling may utilize two

differing methods to derive suitability indices: the point-grid system used in the Forest-wide Tongass Land Management Plan Revision efforts or a "polygon-based" system that provides a finer level of differentiation among habitat types. The point-grid system was used to estimate habitat suitability for bald eagle and river otter, while the polygon-based system was employed to more precisely estimate habitat capability for Sitka black-tailed deer, marten, and black bear. For ease of interpretation, the results are summarized as follows: "good" habitat, representing HSIs of 0.7 to 1; "average" habitat for HSIs of 0.3 to 0.7; "below-average" habitat for HSIs between 0 and 0.3; and "unsuitable" habitat where HSI=0. The following sections discuss each Shamrock MIS and the corresponding habitat suitability of the Shamrock area for each species (Table 3-4).

Sitka Black-Tailed Deer

Sitka black-tailed deer utilize a wide variety of the habitats present in the Shamrock area. In summertime deer may range from alpine habitats through forested regions and down to tidal lowlands. Winter weather will drive deer from the uplands down into lower elevation forests and tidal lowlands. Because winter severity is a major limiting influence to deer survival, the capacity for an area to support deer is largely based upon the suitability of the deer winter range habitat.

Modeled suitability of deer winter range is a function of multiple habitat characteristics: forest type (commercial or non-commercial), the productivity of wood in the forest (volume class), the successional stage of the forest (stages from clearcut through old-growth), the tree species (e.g., hemlock, spruce, cedar, and combinations thereof), elevation, aspect (slope orientation: north, south, east, west), winter severity (low, medium, or high), and presence of predators (gray wolves). The Shamrock area

Table 3-4
Habitat Suitability for MIS in the Shamrock Area

MIS	Good Habitat $0.7 < HSI^1 \leq 1$ (acres; percent[2])	Average Habitat $0.3 < HSI \leq 0.7$ (acres; percent)	Below-Average Habitat $0 < HSI \leq 0.3$ (acres; percent)	Unsuitable Habitat $HSI = 0$ (acres; percent)
Sitka Black-tailed Deer	0	8,947 8.3%	78,711 72.8%	20,513 19.0%
Marten	12,756 11.8%	29,941 27.7%	47,264 43.7%	18,210 16.8%
Black Bear[3]	43,450 40.2%	51,334 47.5%	6,451 6.0%	6,936 6.4%

Source: Fendick and Gunther, 1993
[1] Habitat Suitability Index (HSI) calculated by polygon-based habitat capability models.
[2] Corresponding (rounded-off) percentages of total Shamrock Area acreage (108,171 acres).
[3] For black bear only, "good" habitat is ≥0.7 and "average" habitat is <0.7. A considerable proportion of upland habitat utilized by bear is given a suitability index = 0.7, so this was included in the "good" category.

is almost exclusively hemlock-spruce commercial forest of high wood productivity, i.e., hemlock-spruce old-growth, with moderate to severe winter conditions and the presence of wolves. Consequently, variation in deer winter range suitability within the Shamrock area is primarily due to elevation and aspect. Given these particular generalizations about the Shamrock area, there is no "good" ($HSI>0.7$) deer winter range in the Shamrock area. "Average" habitat ($0.3<HSI\leq0.7$) would occur primarily on forested slopes below 800 foot elevation. "Below-average" habitat ($0<HSI\leq0.3$) occurs on all forested slopes at elevations between 800 feet and 1200-1500 feet (depending on aspect), while "unsuitable" habitat ($HSI=0$) occurs in all higher-elevation forest land. Actual modeled suitability, however, will differentiate habitats within the Shamrock area to a finer level of detail.

The habitat capability model for Shamrock deer winter range indicates that 19 percent of the area is "unsuitable," 73 percent is "below-average," and only 8 percent is "average" habitat (Table 3-4). Suitability was modeled using assumptions of severe winter conditions in VCUs 436 and 428 and moderate winter conditions in VCU 429 (based on the typical winter conditions for these areas) and also modified by the presence of predators. Within the Shamrock area, the nearly 9,000 acres currently classified as "average" is the habitat that receives the majority of deer use during hard winters (Blatt and Doerr, undated). Thus, the results from generalized habitat capability simulations must be viewed with consideration of the behavior of deer within the specific area. The lack of "good" habitat does not preclude utilization of the area by deer, but does indicate that the deer winter range in the Shamrock area is of lower quality than winter range found in other areas in Southeast Alaska.

Deer utilize *Vaccinium* spp. as a winter food source. *Vaccinium* spp. is rather abundant in the Shamrock area, accounting for 21-50 percent of the vegetative cover in surveyed harvest units. However, red huckleberry (*Vaccinium parvifolium*), a preferred browse species, accounts for less than 1 percent of the vegetative cover in most surveyed parts of the Shamrock area. Browsing evidence present during the wildlife field studies indicates that generally less than 5 percent of the available shrub foliage has been utilized over previous winters.

Deer were historically abundant on Kupreanof Island, but a series of severe winters in the early 1970s substantially reduced the population inhabiting the island. Deer populations have not recovered to pre-1970 numbers, and the hunting season for deer has been closed since 1975. Overall, the factors that have prevented deer populations from recovering to historical numbers are not understood. Predation of deer by wolves and bears is an ongoing ecological pressure that likely has contributed to the slow recovery of the Kupreanof Island deer population. Although the modeled habitat suitability of the deer winter range on Kupreanof Island is low, it is unknown to what degree winter range habitat is a limiting factor to the recovery of the islands' deer population.

Marten

The marten is a furbearing mammal that inhabits old-growth forest, but can also range through habitats adjacent to coastal and freshwater aquatic systems. Specialized features of old-growth forest that are desirable to marten include snags and downed logs that provide cavities for resting and denning, and habitat for prey species. Marten prey on small mammals (such as red squirrel), birds and insects, and also consume fruit.

Habitat suitability for marten is based on a winter-range limitation to survival (as with the Sitka black-tailed deer), and the habitat capability model also incorporates the occurrence and availability of food and cover. For the Shamrock area in general, habitat designated as "good" (HSI>0.7) for marten occurs in any commercial forest (volume class 5 and above) or within 500 feet of beach fringe or riparian corridors, at elevations less than 800 feet. "Average" habitat (0.3<HSI≤0.7) occurs in volume class 4 commercial forest or in forests between 800 and 1,500 feet elevation. "Below-average" habitat (0<HSI≤0.3) is found at elevations greater than 1,500 feet, in non-commercial forest (volume class 3 or below) or in any successional stage other than old-growth. All other habitat is "unsuitable" (HSI=0). The marten habitat capability model indicates that the Shamrock area contains over 12,750 acres (11.8 percent) of "good" marten habitat, almost 30,000 acres (27.7 percent) of "average" habitat, 44 percent of the Shamrock area (>47,200 acres) is "below-average," and the remaining 18,200 acres (17 percent) are "unsuitable" for marten (Table 3-4).

Black Bear

Black bear are far-ranging omnivores common in the Shamrock area. They utilize all available habitats for foraging, although activity is often seasonal, such as gorging on salmon in aquatic habitats during spawning runs or feeding on forest berries during fall. Black bear are also an important recreational and subsistence resource. Bear sign was very common throughout the Shamrock area, and bear were directly observed by both wildlife crews and other ID team members.

The overall habitat suitability for bear is largely a function of availability of food and cover for denning. Forested habitat in the Shamrock area is almost exclusively old-growth hemlock-spruce forest. To generalize about habitat conditions within the Shamrock area, old-growth forested habitat designated as "good" (HSI≥0.7) for bear occurs upland in volume class 4 commercial forest during summer and fall. "Average" forest habitat (0.3<HSI<0.7) occurs during spring and winter in volume class 4 forest, and throughout the year in volume class 5 and above commercial forest. Open-canopied mixed forest-muskeg provide additional "good" habitat during spring and early summer, "average" habitat during late summer and fall, but is "unsuitable" for winter denning. High elevation forest in the subalpine-zone provides "good" habitat during early summer and fall, "average" habitat during late summer, but is "unsuitable" during winter and spring. The bear habitat capability model portrays the Shamrock area as containing 43,450 acres (40.2 percent) of "good" black bear habitat, 51,334 acres of "average" habitat (47.5 percent), 6,451 acres (6 percent) "below-average" habitat, and 6,936 acres (6.4 percent) of "unsuitable" habitat (Table 3-4).

River Otter

River otter are associated with coastal and freshwater aquatic habitats, and their immediate (fringe) environs. The river otter is a furbearing carnivore that utilizes downed-tree "root wads" and trunks for denning sites and cover. When downed trees occur directly in waterways, the trees also provide habitat for prey species. Although fish are generally preferred as a food source, river otter along coastal fringes may also consume a variety of marine invertebrates (mollusks, crab, echinoderms, etc.).

Habitat suitability for river otter is based upon cover attributes, vegetation, estimated fish abundance, and waterbody size. There are 8,686 acres of potential river otter habitat within the Shamrock area (8.0 percent of the total area), including all habitats with HSI>0. Areas with the greatest suitability are found in old-growth forest within 500 feet of saltwater, in riparian corridors under 800 ft elevation that border Class I

and II streams, or lakes greater than 50 acres in size. Lesser degrees of suitability are found in riparian corridors at higher elevations or adjacent to forests that are less desirable for commercial harvest.

Bald Eagle

Bald eagle are ubiquitous in Southeast Alaska along coastal and inland aquatic habitats. Nesting occurs in large trees within these aquatic fringe habitats, typically within 500 feet of the waterbody. Although bald eagles are generally ascribed as scavengers, they will forage for live fish on occasion.

A helicopter survey for bald eagle nests was conducted by Forest Service biologists along the Shamrock area shoreline bordering Duncan Canal, around Irish Lakes, and around the unnamed lakes often referred to as Kluane Lakes. No nests were observed in the inland lake surveys. Four bald eagle nests were observed in the Shamrock area near Duncan Canal (Iverson, 1992). Two of the nests were active, with incubating adults present, and two nests were empty. One nest known from past surveys was no longer present. Additional shoreline extending away from the Shamrock area boundaries was also surveyed. Three active nests and two empty nests were observed. Nests were not found at two locations where nests had been observed during previous surveys.

Habitat suitability for the bald eagle is primarily a function of proximity to water, elevation, stream class, lake size, and vegetative cover. There are 4,982 acres of potential bald eagle habitat within the Shamrock area (4.6 percent of the total area), including all habitats with HSI>0. Areas with the greatest suitability are found adjacent to coastal habitats, while lesser degrees of suitability are found along riparian fringes bordering low-elevation rivers and lakes.

Summary of Results from Habitat Capability Models

Because the Shamrock area is predominantly a forested region, suitability modeling of deer, marten, and black bear are the most informative because among the MIS modeled they are the most dependent upon old-growth forested habitats. However, the extensive, relatively homogeneous old-growth characteristics of most of the Shamrock area are not of the highest suitability for winter range of Sitka black-tailed deer. In all, greater than 81 percent of the Shamrock area is potential habitat for these three species. Less than 9 percent of the Shamrock area is potential habitat for the bald eagle and river otter, species that prefer coastal or riparian habitats.

Threatened, Endangered, Candidate, and Sensitive Species

Some wildlife species potentially occurring in or around Kupreanof Island are recognized by the federal government as threatened or endangered, are candidates for federal listing, or are considered sensitive species by the Forest Service. Although species officially recognized as threatened or endangered are protected under provisions of the Endangered Species Act of 1973, candidate species are not protected. Forest Service designation as "sensitive" requires special consideration during planning processes, but there is no protection under the Endangered Species Act for sensitive.

Threatened Species

Steller sea lions are likely to occur around Kupreanof Island. Haul-outs, rookeries, or both, are known historically from the Turnabout Islands, off the northwest coast of

Kupreanof Island (Calkins, 1986). There are no currently-known haul-outs or rookeries on Kupreanof Island (Mello, 1992). Sea lions will readily exploit salmon fisheries and other marine aquatic species as food sources (Hoover, 1988), and thus may potentially occur in Shamrock area marine and estuarine habitats in pursuit of food.

Spectacled eider was recently listed as threatened. This species is most likely a casual or occasional visitor to Southeast Alaska (Holmberg, 1992). Eiders favor marine habitats, which for the Shamrock area is restricted to the Duncan Canal estuarine tidal flats.

Endangered Species

Several endangered whale species potentially utilize the waterways surrounding Kupreanof Island; the most likely present species is the humpback whale. The humpback whale has been observed within Duncan Canal (National Marine Mammal Laboratory, 1992) and is a year-round resident in Southeast Alaska. The gray whale, which is typically seen only as it migrates between more northerly summer waters and winter breeding grounds, was previously a federal endangered species but was recently delisted. Six other endangered whale species (sperm, finback, Sei, blue, right, and bowhead whales) are either unlikely to occur or are only sporadically observed in interior Southeast Alaskan waterways. There is no recognized critical habitat for any of these species within the Shamrock area, although Duncan Canal potentially supports populations of herring and other food resources for whale species.

The American peregrine falcon may occur in the Shamrock area, but no critical habitat has been designated for this species. This peregrine falcon subspecies would most likely be a transient, appearing in the Shamrock area only during the seasonal migration periods (Holmberg, 1992).

Candidate Species

There are two categories of candidacy for federal designation as threatened or endangered. Category 1 candidates are species for which sufficient biological information exists to warrant official designation, but the administrative process for listing has not been completed. Category 2 candidates are species for which there is information indicating the species may qualify for threatened or endangered status, but further biological information is needed.

One Category 1 candidate species potentially present in the Shamrock area is Steller's eider. Like the spectacled eider, this bird is most likely a casual or occasional visitor to Southeast Alaska (Holmberg, 1992). The eiders favor marine habitats, which for the Shamrock area is restricted to the Duncan Canal estuarine tidal flats.

Currently Category 2 species are marbled murrelet, Kittlitz murrelet, northern goshawk, harlequin duck, olive-sided flycatcher, Alexander Archipelago wolf, North American lynx, bull trout, and spotted frog. Field surveys conducted in the Shamrock area for the marbled murrelet and the northern goshawk are discussed in the following text. Numerous harlequin ducks were observed in both Sumner Strait and Frederick Sound during Shamrock EIS field activities, while the status of the spotted frog on Kupreanof Island is uncertain.

The marbled murrelet has been recently designated as threatened in the lower 48 states and is being considered for this listing in Alaska. The marbled murrelet is a

seabird that nests primarily in the upper canopy of old-growth coniferous forests throughout the Pacific Northwest and Southeast Alaska. Most nesting activities are associated with forested land within 45 miles of the coast, but throughout the world less than 30 nests of this species have been located. Nests and breeding activity of marbled murrelets are difficult to observe because the birds are silent throughout most of the day when they are on the nests. Otherwise they are feeding in adjacent saltwater waterways.

To determine if marbled murrelets utilize the Shamrock area, the wildlife crews surveyed portions of the waterways surrounding Kupreanof Island and also surveyed selected inland harvest units. From the boat surveys, both single and paired marbled murrelets were observed in the surveyed transects. However, the data collected were insufficient to determine if preferred foraging areas exist. Bird counts varied among days, and other factors such as water depth, sea conditions, time of day, and tide level may have influenced bird distribution. The data simply indicate that marbled murrelets utilize the waterways surrounding Kupreanof Island.

Land-based surveys for marbled murrelets occurred in June 1992. Counts were conducted from muskeg adjacent to proposed harvest units for unobstructed views of flying birds, and started about 1-1/2 to 1 hour before the approximately 4:00 a.m. sunrise. At this time, one member of the breeding pair exchanges nest responsibilities with the other, circling the area overhead and voicing distinctive calls. Soon after sunrise, the birds stop this aerial display and either settle into their nest or move to waterways. Because no nests were located or birds seen flying directly out of a particular unit, no specific area can be singled out as a more important breeding location. Additionally, other biological and environmental cues affecting daybreak activity of marbled murrelets cannot be controlled. For example, counts under cloudy and drizzly conditions resulted in the highest single count when compared to days with no cloud cover. Furthermore, censuses occurred only once at each site and day-to-day variability could not be quantified. However, survey results indicate that marbled murrelets are widely distributed throughout the Shamrock area wherever old-growth forest occurs.

Surveys for northern goshawk, using broadcasts of tape-recorded vocalizations, were conducted throughout June and July. No goshawk activity was observed within the harvest units visited by the wildlife crew. However, three goshawk nests were found in the Big John Creek drainage in the northwestern portion of the Shamrock area. The area of the nest sites is approximately 1.5 miles northwest of the closest harvest unit for the proposed Shamrock harvest.

The Alexander Archipelago wolf (*Canis lupus ligoni*) is considered a distinct subspecies of gray wolf (Pederson, 1982) and is currently a Category 2 candidate species for listing as threatened or endangered by the USFWS. The range of this subspecies includes the islands south of Frederick Sound and the mainland area west of the Coast Mountains from Dixon Entrance to Yakutat Bay (Hall, 1981). Kirchhoff (1991) estimated the total wolf population in Southeast Alaska at 635 to 690 individuals, with greatest densities in the southern panhandle and lowest densities on the mainland. Intermediate densities of wolf occur on Kupreanof and neighboring islands.

The primary prey species for wolves in Southeast Alaska is Sitka black-tailed deer, although their diet can also include other mammals (e.g., moose, mountain goats, and beaver) and spawning salmon. Although wolves are wide ranging and do not show a preference for a particular type of habitat, old-growth forest is critical to maintaining

wolf populations in Southeast Alaska due to its importance as winter habitat for Sitka black-tailed deer. Shooting and trapping by humans is a major cause of wolf mortality in Southeast Alaska, and increases in access and population are likely to result in lower wolf densities. When wolf populations decline on islands in the Alexander Archipelago, inbreeding may contribute to further reductions in population viability (Kirchhoff, 1991).

The olive-sided flycatcher has recently been added as a Category 2 species. The species ranges roughly from interior Alaska to Baja California, through the Rocky Mountain states and east through Canada and the New England states. Information on the olive-sided flycatcher within the Petersburg Ranger District is rather limited, but locally it is considered an uncommon breeder and a rare migrant (Walsh, personal communication). Information gathered by Walsh, suggests the population is stable on Mitkof Island. We believe this is true for other areas on the district. This flycatcher utilizes semi-open areas and forest edge habitat such as beaver ponds and young managed stands (Walsh, personal communication and Blatt, personal observation).

Conducting surveys for northern goshawks in the Shamrock area

The Kittlitz murrelet has recently been added as a Category 2 species. Information on the Kittlitz murrelet within the Petersburg Ranger District is rather limited. Kittlitz murrelet are locally very rare with observations occurring at Thomas Bay and historical records of occurrence at LeConte Bay (Walsh, personal communication). In Southeast Alaska, this murrelet is uncommon, with a center of distribution located at Glacier Bay, Alaska. Kittlitz murrelets nest on bare rock some distance from the sea and occur at primarily high elevation near the tops of mountains (Harrison 1987). The Kittlitz murrelet is not known to occur within the study area.

The North American lynx and bull trout are two additional Category 2 species that occur in Southeast Alaska, but they are known only from mainland locations. They therefore would not be expected to occur in the analysis area.

Sensitive Species

The Alaska Region's Sensitive Species List released in January 1994 included 10 animal species, including:

Common Name	Scientific Name
Montague Island tundra vole	*Microtus oeconomus elymocetes*
Trumpeter swan	*Cygnus buccinator*
Dusky Canada goose	*Branta canadensis occidentalis*
Queen Charlotte Goshawk	*Accipiter gentilis laingi*
Osprey	*Pandion haliaetus*
Peale's peregrine falcon	*Falco peregrinus pealei*
Northern pike	*Esox lucius*
Fish Creek chum salmon	*Oncorhynchus keta*
King Salmon River and Wheeler Creek king salmon	*Oncorhynchus tshawytscha*

Osprey are present in the Shamrock area. An active nest was observed along the tidal-flat shoreline bordering Duncan Canal by Forest Service biologists in aerial surveys of estuarine and freshwater habitats in the Shamrock area (Iverson, 1992). No other osprey or osprey nests were observed in the Shamrock area by this Forest Service survey, or during field activities of the Shamrock ID team. Peale's peregrine falcon nests elsewhere in Southeast Alaska, but is not known to occur in the Shamrock area. Trumpeter swan have been observed during mild winter conditions in the Irish Lakes region (Walsh, 1992). Northern (Queen Charlotte) goshawks are known to occur in the area, and three nests have been identified in the Shamrock area near Big John Lake. Other nests have been located south of the Shamrock area on Kupreanof Island. None of the other species on the January 1994 Alaska Region Sensitive Species List are known to occur in the vicinity of Kupreanof Island.

Additional Special-Status Species

The USFWS expressed concern for the Vancouver Canada goose, a species outside of threatened, endangered, candidate, sensitive, or project MIS status. The Vancouver Canada goose is a commonly-observed breeding species of waterfowl in Southeast Alaska (Taylor, 1979). A Canada goose nest was observed at two unnamed lakes near Harvest Units 1 and 2 (locally called Kluane Lakes) in the Shamrock area, and several were heard flying overhead on other occasions.

Fish

The Shamrock area includes several river drainages that collectively contain chum, coho, pink, and sockeye salmon; steelhead and cutthroat trout; and Dolly Varden char. These drainages support a limited recreational fishery, primarily for coho salmon and steelhead, and contribute to a larger commercial fishery for pink and coho salmon. Both the recreational and commercial fisheries are important to the local economy of the area, and these fish populations contribute to the subsistence needs of local communities.

Large estuarine channels provide spawning habitat for coho, pink, and chum salmon

Stream Classification and Drainage

Stream drainages within the Shamrock area have been categorized according to the types of fish present or potentially present. Class I streams meet one of three conditions: they provide anadromous and adfluvial fish habitat; they would provide anadromous habitat if passage facilities allowed fish to negotiate downstream migration barriers; or they contain resident trout populations considered important for sport fishing. Class II streams support resident fish populations only and generally have steep gradients (6-15 percent) that limit sport fisheries values. Class III streams do not contain fish, although they can affect downstream water quality and fish habitat.

Drainage basins within the Shamrock area include Big John Creek (ADF&G Stream Number 105-32-10160), Castle River (106-43-10210), Keku Creek (105-32-10120), Tunehean Creek (105-32-10040), and several unnamed basins (106-43-10450, 106-43-10440) that flow east out of the study area into Duncan Canal (Figure 3-2). The largest basin is Keku Creek, which covers 36.22 mi^2 or 23.4 percent of the analysis area (Table 3-5). Castle River, the second largest basin, covers 32.61 mi^2 or 21.3 percent of the area. Tunehean and Big John cover 27.69 mi^2 and 13.89 mi^2, respectively.

Figure 3-2. Fish Study Reach Locations and Watershed Boundaries in the Shamrock Area

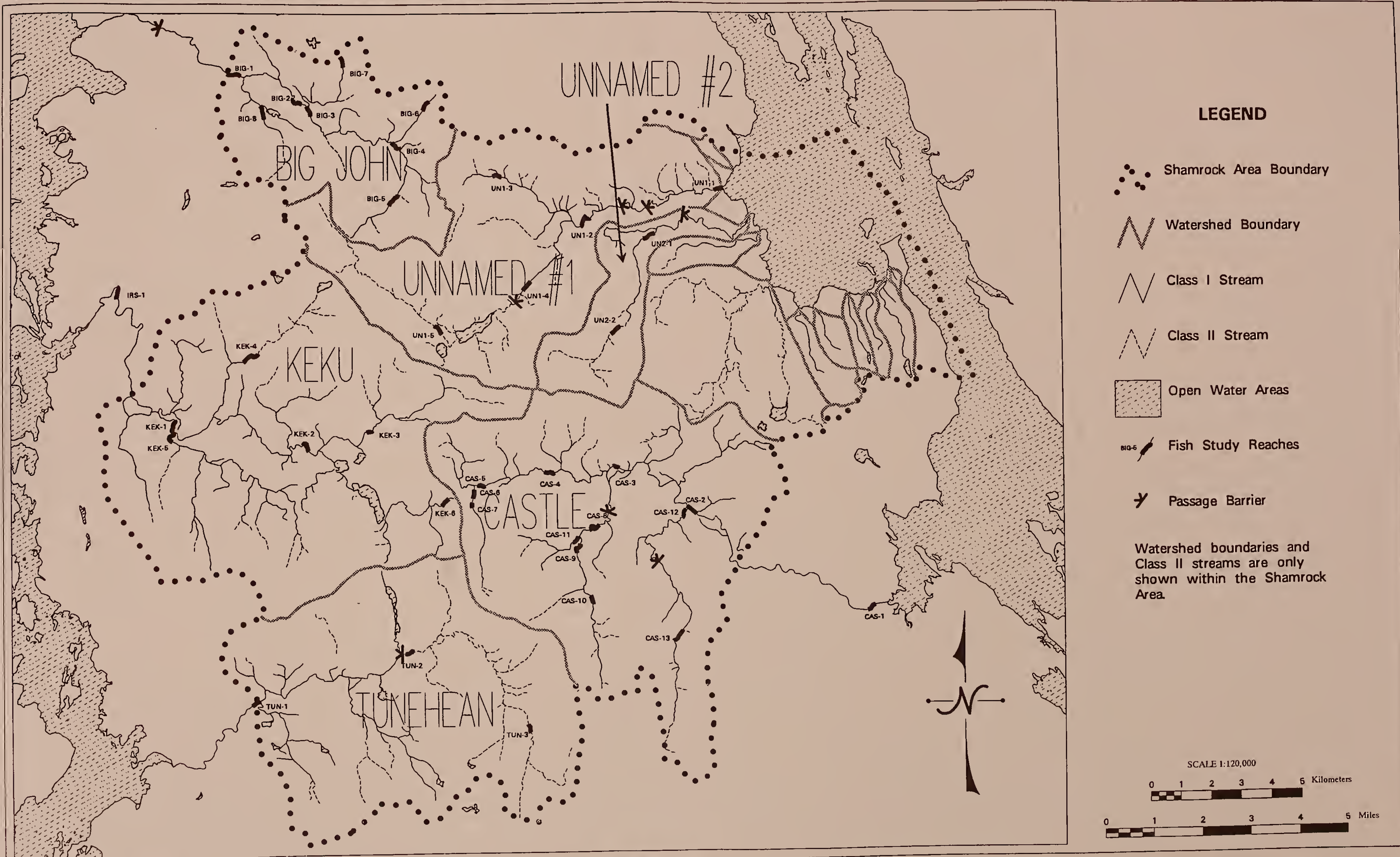


Table 3-5
Watershed Area, Stream Class by Mile and Total Stream Miles[1]

Watershed	Area Square Miles	Stream Class (mile) I	II	III	Total Stream Miles
Big John Creek	13.89	18.65	3.38	4.54	26.56
Castle River	32.61	42.86	7.41	12.48	62.75
Keku Creek	36.22	47.32	13.16	18.13	78.61
Tunehean Creek	27.69	19.05	22.85	18.91	60.81
Unnamed Creek 1	22.89	15.35	17.69	17.55	50.59
Unnamed Creek 2	5.99	7.20	3.83	2.70	13.73
All Other Unnamed	13.69	9.27	16.45	0.00	25.75
Totals	**152.98**	**159.70**	**84.77**	**74.30**	**318.77**

Source: Barrett, 1993
[1] Information obtained from the field verified GIS database, streams layer.

Big John Creek

Big John Creek is located in the northwestern portion of the Shamrock area and drains northwest into Big John Bay. This drainage consists of two distinctive channel types: (1) contained areas with bedrock substrates and (2) low-moderately contained areas with cobble and gravel substrates. Contained channel areas generally lack substrate and in-stream shelter and, consequently, have low habitat value. Low-moderately contained areas generally have extensive pool development, spawning gravels, and in-stream shelter that produce good conditions for fishes. Water temperature has not been identified as a potential problem on this drainage. An impassible fall is present on the mainstem of Big John Creek approximately 1.5 miles upstream from the river's mouth. The lower reaches of the mainstem contain coho, chum, and pink salmon, steelhead, and cutthroat trout. ADF&G escapement estimates range from 900 to 3,100 for pink salmon and 150 to 3,800 for chum salmon during the period 1984 to 1989 (Lynch, 1992). Recreational fishing is conducted primarily along the lower reaches of Big John Creek.

Castle River

Castle River is located in the central portion of the Shamrock area and flows east into Duncan Canal. The mainstem of the river is generally wide and low gradient, with extensive glide and run habitats and side channel areas. Tributaries to the Castle are mostly moderately to highly contained with extensive riffle and pool habitats. Large woody debris (LWD) is distributed throughout the drainage, offering cover for fish and creating a diversity of habitats. Habitat conditions, in general, are "good" throughout the drainage although concerns about water temperatures in the mainstem were raised during the public scoping period (Knight, 1992) and temperatures in excess of 65°F were observed during June 1992. No major fish passage barriers are present within the drainage. The Castle River contains coho, pink, and chum salmon; steelhead and cutthroat trout; and Dolly Varden char. ADF&G has conducted very few surveys of escapement in this drainage. Available estimates include 200 pink salmon and 160 to 2,300 chum salmon during the period 1981 to 1987. The coho and steelhead populations are subject to large recreational fisheries in August-September and April-May, respectively.

Analyzing stream geomorphology in the Shamrock area

Keku Creek

Keku Creek is also located in the central portion of the study area but flows west into Rocky Pass. Several large lakes, collectively termed Irish Lakes, are located in the headwaters of Keku Creek. Channel and habitat conditions are similar to those on Castle River. Water temperature has not been identified as a potential problem on this drainage, although temperatures in excess of 64°F were observed in June 1992. Two major fish passage facilities are present on Keku Creek, one near its mouth and another approximately 2 miles upstream. The drainage supports pink, chum, and coho salmon; steelhead and cutthroat trout; and Dolly Varden char. ADF&G escapement estimates taken in Irish Creek range from 150 to 8,000 for pink salmon and 300 to 4,500 for chum salmon during the period 1981 to 1989. The Keku drainage is an important rearing area for juvenile coho salmon (Johnson, 1992). Irish Lakes support populations of cutthroat trout and kokanee salmon (landlocked sockeye). A limited amount of recreational fishing occurs along the lower portion of Irish Creek and in the Irish Lakes area.

Tunehean Creek

Tunehean Creek is located in the southwestern portion of the Shamrock area. It flows west into Keku Strait. Channel and habitat conditions vary with location. The lower third of Tunehean is a broad, low gradient reach similar to the mainstem Castle River. The remaining portion of Tunehean contains areas with eroding banks, bedrock substrates, or low large woody debris (LWD) levels that result in poorer quality habitat. Two falls located on Tunehean Creek, approximately 6 miles upstream from its mouth, prevent fish passage. No fish passage facilities are present at these barriers. Consequently, much of the drainage is classified as Class II waters. Fish kills from high water temperatures have been reported in this drainage (USDA Forest Service, 1984b), and temperatures in excess of 64°F were observed during July 1992. Tunehean Creek supports pink, chum, sockeye, and coho salmon; steelhead and cutthroat trout; and Dolly Varden char. ADF&G escapement estimates range from 3,000 to 142,000 for pink salmon and 30 to 8,300 for chum salmon, and a single estimate of 6 sockeye salmon during the period 1981 to 1991. Recreational fishing on this system is limited.

Aquatic habitat in the Keku River drainage

Unnamed Drainages

Of the unnamed drainages that flow east to Duncan Canal, only Unnamed 1 and Unnamed 2 (Figure 3-2) are large enough to support major anadromous fish populations. Both originate in the northern portion of the study area. The mainstem and north fork of Unnamed 1 are mostly low gradient contained or uncontained (i.e., floodplain) channels with pool, riffle, and run habitats. LWD is common in upstream areas. Overall, habitat conditions are "good" in these areas, although extensive bank erosion occurs in some upstream areas. The south fork of Unnamed 1 initially passes through an uncontained floodplain but then enters a highly contained valley dominated by cascade and riffle habitats. A large, impassable fall is located at the head of this canyon. Habitat value throughout this reach is low. Above the falls, habitat conditions are similar to those on the upper mainstem. Water temperature has not been identified as a potential problem on this drainage. Two unnamed lakes containing cutthroat trout are located in this reach. Field surveys identified coho salmon and cutthroat trout in Unnamed 1. No ADF&G escapement estimates are available for this drainage.

Habitat conditions in the lower portion of Unnamed 2 are similar to those on the mainstem of Unnamed 1. The upper portion of Unnamed 2 is highly contained and has generally poor habitat conditions. Water temperature has not been identified as a potential problem on this drainage. No information is available on the types of fishes present within this drainage.

Biodiversity

The concept of biodiversity encompasses a variety of abiotic and biotic elements that collectively characterize the diversity of organisms, communities, and ecosystems of a given area or region. The Office of Technology Assessment (OTA) defines biodiversity as "...the variety and variability among living organisms and the ecological complexes in which they occur" (OTA, 1987). Biodiversity includes compositional (e.g., numbers of species), structural (e.g., habitat complexity), and functional (e.g., nutrient cycling) components (Noss, 1990; Sharitz et al., 1992). Old-growth forest and its associated wildlife are particularly important to biodiversity in Southeast Alaska (Suring et al., 1992) and are covered in more detail than other biodiversity elements. Because biodiversity includes elements from several other resource areas, some of the discussion below summarizes material presented in other sections of this chapter, which can be referred to for a more thorough analysis.

Physical Processes and Characteristics

The Shamrock area is located in the western, central portion of Kupreanof Island, a part of the extensive archipelago that comprises much of Southeast Alaska. Physical characteristics of the analysis area determine the setting in which the diversity of plants and animals occur. The extent and nature of biodiversity within a region depends on the degree of habitat heterogeneity, natural disturbance, resource availability, and environmental severity, which are all in part a result of these physical (i.e., abiotic) processes. Because the Shamrock area is located on an island, its biodiversity is potentially affected by migratory barriers to plant and animal species that cannot easily cross open water (MacArthur and Wilson, 1967). However, the narrow channels between Kupreanof Island, other islands, and the mainland are likely to substantially reduce any such effects of island biogeography.

Typical forested habitat in the Shamrock area

Within the area is a mix of flat or gently sloping terrain, steep slopes which occur on numerous ridges, and peaks that reach 2,500 feet in elevation. High annual precipitation (averaging 104 inches in Petersburg) in a relatively mild marine climate results in dense temperate rainforests and extensive boggy areas, known regionally as muskeg. Heavy winds often accompany major winter storms, and windthrow is the primary form of natural disturbance to forest communities in Southeast Alaska. Mass wasting on steep slopes is of secondary importance as a disturbance agent, and fire plays a very minor role (Alaback and Juday, 1989).

Major streams in the Shamrock area include Castle River, Tuneahan, Keku, Big John, and two unnamed creeks in the northeast portion of the area. They are fairly typical for lowland streams in Southeast Alaska, with moderately high base flows which support several anadromous fish populations. There are a few small to medium size lakes in the area, of which Irish Lakes and an unnamed lake (110 and 95 acres, respectively) are the largest. Marine shoreline occurs along Duncan Canal in the northeast portion of the Shamrock area.

Distribution of Habitat Types

The Shamrock area was classified according to six habitat types to examine the degree of habitat heterogeneity. By far the most abundant habitat type is forest, comprising approximately 80 percent of the analysis area (Table 3-6). Muskeg was the second most abundant habitat type, totalling 16 percent. Subalpine-alpine, riparian, estuarine fringe, and beach fringe habitats are all in minor proportions in the analysis area.

Forest

Forest habitat is dominated primarily by western hemlock and Sitka spruce, with Alaska-cedar and shore pine secondary in importance. Mountain hemlock is also found in the analysis area, occurring at elevations above 1,500 feet. In general, the more productive forest stands occur on better drained sites, such as moderately steep slopes and floodplain areas. As soils become more poorly drained, forest stands diminish in volume eventually grading into scattered shore pine within muskeg.

Structural features of old-growth forest habitat in the Shamrock area appear to be typical for Southeast Alaska. Forests are heterogeneous in the size and amount of living trees, the amount of large standing dead and fallen logs, the composition and density of understory, and the degree of canopy closure. This heterogeneity in structure occurs mostly in smaller patches of one to several acres, consistent with the scale of windthrow disturbance in forests of Southeast Alaska (Harris, 1989). In the Pacific Northwest, the mosaic of successional stages created by natural disturbance have been found to provide suitable habitat for most species of forest plants and vertebrate animals (Hansen et al., 1991).

Muskeg

Muskeg is scattered throughout the analysis area, occurring typically on flat to gently sloping sites. The species composition of muskeg vegetation in the Shamrock area varies. Typically there is a matrix of sphagnum moss, within which grow a variety of low growing shrubs (such as bog laurel, Labrador tea, bog blueberry), herbaceous plants (such as deer cabbage, caltha leaved avens, buckbean, and round-leaved sundew), and sedges. Stunted shore pine 10 to 15 feet high occur as individuals or in small groves scattered throughout the muskegs. Muskegs often contain small ponds and are underlain by peat deposits up to 30 or 40 feet deep.

Table 3-6
Biodiversity Elements and Characteristics for the Shamrock Area, Tongass National Forest

Biodiversity Element	Characteristics	
Physical Processes		
Geology/Geomorphology	Island location a mostly basalt bedrock with surface deposits of glacial till. Flat to moderately hilly terrain, with a few high ridges over 2,500 feet.	
Climate	High precipitation; high winds during winter a major disturbance factor; low spatial variability in climatic conditions.	
Soils	Spodosols in forests, deep peat deposits in muskeg. Mass wasting occurs on steep slopes.	
Hydrology	Several large streams with average annual discharges typical for lowland Southeast Alaska. High water table and saturated soils throughout area.	
Habitat Types		
Forest	82,000 acres	Primarily western hemlock and Sitka spruce, with lesser amounts of Alaska yellow cedar, shore pine, and mountain hemlock.
Riparian	3,300 acres	Shrub areas dominated by salmonberry, thimbleberry, and spiraea; forested areas mostly coniferous, with some red alder.
Muskeg	16,200 acres	Throughout Shamrock area on flat to gently sloping sites.
Beach Fringe	227 acres	Approximately 2 miles of gravel-rocky shoreline along Duncan Canal.
Estuarine Fringe	1,026 acres	Approximately 6 miles of estuarine-tidal mudflat shoreline along Duncan Canal.
Subalpine-Alpine	3,100 acres	Several high ridges within area, with mountain hemlock forest grading into open subalpine shrubs and herbs.
Old-growth Forest Volume Class		
Vol. Class 3 (< 8 MBF/acre)	22 acres	(Note: Old-growth forest is restricted to areas coded as stand-size Class 4 in the timber type data layer, Stikine Area GIS database.)
Vol. Class 4 (8-20 MBF/acre)	25,899 acres	
Vol. Class 5 (20-30 MBF/acre)	15,073 acres	
Vol. Class 6 (30-50 MBF/acre)	3,186 acres	
Vol. Class 7 (> 50 MBF/acre)	225 acres	
Total	44,405 acres	

Table 3-6 (Continued)

Old-growth Forest Block Size	All Old Growth		Old Growth Volume Class 6-7	
	Total Acres	Number of Blocks	Total Acres	Number of Blocks
< 100 acres	2,677 acres	139	2,392	90
100-500 acres	2,076 acres	12	1,091	8
501-1000 acres	0 acres	0	0	0
> 1000 acres	39,650 acres	6	0	0

Management Indicator Species	Habitat Suitability (percent of Shamrock area)			
	Good	Average	Below-Average	Unsuitable
Sitka Black-Tailed Deer	0	8	73	19
Marten	12	28	44	17
Black Bear	40	48	6	6

Threatened, Endangered, Sensitive, and Candidate Species	
Animals	Marbled murrelet (no official status) occurs throughout forested areas. Osprey (Forest Service sensitive species), and bald eagle (no official status in Alaska) nests observed along Duncan Canal. Northern goshawk (Forest Service Sensitive) nest in northwest corner of Shamrock area.
Plants	Menzies' spiraea (*Spiraea douglasii*) only rare plant identified in area.
Fisheries Habitat and Populations	
Castle River	Coho, pink, and chum salmon; steelhead and cutthroat trout; Dolly Varden char. Good habitat throughout drainage.
Keku Creek	Coho, pink, and chum salmon; steelhead and cutthroat trout; Dolly Varden char. Good habitat throughout drainage, two fish passage facilities; important rearing area for juvenile coho.
Tunehean Creek	Coho, pink, chum, and sockeye salmon; steelhead and cutthroat trout; Dolly Varden char. Higher quality, habitat in lower reaches, poor quality in upper two-thirds.
Big John Creek	Coho, pink, and chum salmon; steelhead and cutthroat trout. Good habitat in lower reaches, with passage barriers to upstream reaches.
Unnamed Creek #1	Coho salmon, cutthroat trout (but data incomplete). High quality habitat in lower reach; passage barriers to upper reaches, but some good habitat in upper reaches.
Unnamed Creek #2	No information on types of fish. Lower portion with good habitat conditions; upper portion generally poor habitat.

Source: Chapin 1992b

Subalpine-Alpine

No true alpine habitat occurs in the Shamrock area, but there are several high ridges above 1,500 feet elevation where subalpine vegetation occurs. Subalpine vegetation on Kupreanof Island consists of forest dominated by mountain hemlock opening up into herbaceous and shrubby areas. Common herbaceous plants include sedges, cottongrass, deer cabbage, small flowered Indian paintbrush, and narcissus anemone. Shrubs include typical subalpine species such as mountain heather, dwarf and alpine blueberry, and copper-flower.

Beach fringe habitat adjacent to Duncan Canal

Riparian

Riparian habitat is located along the banks of larger streams (e.g., Castle River, Tunehean Creek, and Keku Creek) and lakes (e.g., Irish lakes). Riparian vegetation in the Shamrock area is varied, including shrub and both deciduous and coniferous forested communities. Shrub communities are typically dominated by salmonberry, thimbleberry, and Menzies' spiraea. Red alder is the only deciduous tree species common in forested riparian communities and is often mixed with coniferous species such as western hemlock and Sitka spruce. Sitka spruce trees occurring in the floodplain of larger streams are often very large, reaching over 7 feet in diameter.

Estuary and Beach Fringe

Because of their proximity to shoreline habitat, estuary and beach fringe habitats are of special importance to many species of wildlife. Typically, coniferous forest extends to near the high tide line, although red alder often occurs in a narrow band at the forest edge. Wildlife species that utilize resources of intertidal ecosystems depend on these areas for cover and transportation. Marine shoreline in the Shamrock area is

limited to about six miles along the estuary in the northeast portion and about three miles along the rock and gravel intertidal shoreline immediately south of this estuary area.

Amount and Distribution of Old-growth Forest

Old-growth forest is of major importance to biodiversity in Southeast Alaska because it provides habitat required by a variety of wildlife species. Several attributes of high-volume old-growth forest (more than 30 MBF/acre or Volume Class ≥ 6) provide unique habitat features that are not found in young stands (Schoen et al., 1988). Large standing-dead trees are important to cavity nesting birds, and downed trees are critical to nutrient cycling processes and reducing soil erosion (Franklin, 1988). High volume old-growth forest provides important winter habitat for Sitka black-tailed deer because the closed canopy filters out heavy snow while the open understory provides adequate forage. These characteristics are lacking in dense second-growth stands and in more open canopy, low-volume forests.

Approximately 41 percent of the total area and 54 percent of forested habitat in the Shamrock area is classified as old-growth forest, defined here as sawtimber ≥ 9 inches diameter and ≥ 150 years old (Table 3-6, Figure 3-3a). Most old-growth is in low-volume stands (less than 30 MBF/acre), while less than 8 percent of old-growth forest is considered high volume. High-volume old-growth is limited on Kupreanof Island due to wet soil conditions and is most prevalent on moderately steep slopes and floodplains, where soils are well-drained. High-volume stands of old-growth are dispersed throughout the Shamrock area, and are found in a mosaic with lower-volume stands and muskeg.

Habitat Fragmentation

Approximately 90 percent of old-growth forest in the Shamrock area occurs in six large contiguous areas, or blocks, greater than 1,000 acres (Table 3-6, Figure 3-3b). In particular, there are two blocks greater than 10,000 acres each that account for almost 70 percent of the old-growth in the area. There are 139 blocks of old-growth less than 100 acres (totalling 2,677 acres) identified in the Shamrock area, indicating that patches of this habitat are common in a mosaic with other habitat types. There are also 2,076 acres of old-growth in 12 blocks 100 to 500 acres in size, but curiously no blocks between 500 and 1,000 acres.

From this size distribution, it is evident that most old-growth in the Shamrock area is in large, contiguous blocks that are well above the optimal areas for most old-growth dependent species. For example, optimal old-growth area for marbled murrelet is 500 acres; for Sitka black-tailed deer it is 1,000 acres, for red-breasted sapsuckers it is 250 acres; and for hairy woodpecker it is 500 acres (USDA Forest Service, 1990). The distribution of high-volume old-growth forest, however, is dispersed, occurring primarily in patches less than 100 acres. Although these patches usually occur within larger patches of lower volume old-growth, they may be effectively below optimal patch size for some species (e.g., Sitka black-tailed deer) that have habitat requirements unique to high-volume forest.

Wildlife and Management Indicator Species

Results from wildlife surveys indicate that the assemblage of vertebrate animal species is typical for this portion of Southeast Alaska (see section on wildlife). Evidence of large mammals, including deer, moose, wolf, and black bear was abundant, although the number of individuals observed was very limited. Other animals recorded during the surveys, either through direct observations or sign of their occurrence, included river otters, beaver, red squirrel, porcupine, and three amphibians. A total of 53 bird species from 24 families were observed in and around the Shamrock area.

In lieu of more complete information on number and abundances of animal species, Management Indicator Species (MIS) can be used to assess the relative capability of an area to support its characteristic assemblage of species. For purposes of assessing biodiversity, the output of habitat capability models for three MIS (Sitka black-tailed deer, marten, and black bear) were used in the evaluation of habitat conditions (for broader discussion of MIS, see section on wildlife). The Sitka black-tailed deer is a useful indicator for old-growth forest habitat because it depends on the unique structural features characteristic of high volume old-growth stands, particularly for winter range. The marten utilizes old-growth, riparian, beach fringe, and estuarine fringe habitats. Its role as a predator and its range of habitat preferences make it a good general indicator of overall habitat quality. Because black bears are omnivorous, wide ranging, and utilize virtually all habitats in the analysis area, they are useful in assessing habitat quality on a landscape scale.

Habitat capability models for Sitka black-tailed deer winter range indicate that the Shamrock area is largely unfavorable for this species, with 19 percent of the area "unsuitable," 73 percent "below-average," 8 percent "average," and no area found to be "good." These results are consistent with the quantification of old-growth forest by volume class, which showed little high-volume old-growth forest in the Shamrock area, and with the low densities of deer now found on Kupreanof Island following a series of hard winters in the 1970s.

Characteristics important to the marten include specialized features of old-growth forest such as snags and downed logs, which provide cavities for resting and denning and habitat for prey species. Results of the habitat capability model analysis suggest that there is considerable habitat available for marten in the Shamrock area, with 12 percent of the area considered "good" and 28 percent considered "average."

For black bear, habitat suitability is largely dependent on cover and available denning sites, particularly in areas near aquatic habitat. The habitat capability model results indicate that there is abundant "good" (40 percent) and "average" (48 percent) black bear habitat in the Shamrock area.

TES Plants and Animals

As discussed in the TES plants section, there are no federally listed plant species that are known to occur in the Shamrock area or in Southeast Alaska. The TES plant survey in the Shamrock area conducted in 1992, however, identified one species considered rare in Southeast Alaska by the Alaska Natural Heritage Program. This species, Menzies' spiraea (*Spiraea douglasii* subsp. *menziesii*), was found to be common along stream and lake shores, but is at the northern end of its range in the vicinity of Kupreanof Island.

The few TES plants in the Shamrock area and its surrounding region is partly a consequence of the relative lack of uncommon habitat and substrate types. Because the types of vegetation and geology occurring in the area are found extensively throughout Southeast Alaska, there is little opportunity for endemic plant populations to occur. On the other hand, Kupreanof Island is at the northern end of the ranges of several species whose distribution is centered in the Pacific Northwest (i.e., Oregon and Washington), such as Menzies' spiraea and western red cedar. These populations are important because they may represent somewhat isolated gene pools, and they are part of a transition between regional floras.

Animal species of special concern known to occur in the Shamrock area include the marbled murrelet, northern goshawk, and osprey. Marbled murrelets are not officially recognized as a TES species in Alaska, but are a Federal Category 2 species and are

Figure 3-3a. Old-growth Forests Within the Shamrock Area by Volume Class

Figure 3-3b. One Thousand Acre or Larger Old-Growth Forests Blocks within the Shamrock Area

of increasing concern due to their reliance on old-growth forest habitat. During wildlife surveys in June 1992, marbled murrelets were frequently sighted flying over forested areas and on marine waters around Kupreanof Island. The northern goshawk is also a Category 2 species and is an Alaska Region Sensitive Species. No goshawk activity or nests were observed in or near proposed harvest units, although a nest was found in the northwestern portion of the Shamrock area. Nesting osprey, recognized as "sensitive" by the Forest Service, were observed along the tidal-flat shoreline of Duncan Canal in the Shamrock area.

Fisheries Habitat and Populations

Seven salmonid fish species are found within the Shamrock area: chum, coho, pink, and sockeye salmon; steelhead and cutthroat trout; and Dolly Varden char. Information on the distribution of these species among the different watersheds is incomplete, but most watersheds contain at least four of the seven species (Table 3-6). No watershed, however, is thought to contain all seven. These fish species are typical of those in Southeast Alaska, and the area does not contain any unique or endemic species, nor does it lack species that are common in nearby portions of Tongass National Forest.

Most fish populations within the Shamrock area are anadromous (i.e., a life history in which fish spawn in fresh water, but spend at least part of their lives in salt water). Anadromous populations occur in every drainage of the Shamrock area, and only some cutthroat trout and Dolly Varden populations are non-anadromous, or "resident." Because interbreeding of anadromous fishes from different drainages is rare, populations usually develop unique genetic characteristics (Nehlsen et al., 1991). Preservation of these unique gene pools is a major goal of biodiversity related management. Specific management actions include the maintenance of healthy, indigenous populations and avoiding the introduction of non-indigenous stock (e.g., hatchery raised fish from non-native parents).

Overall Assessment of Biodiversity

Biodiversity in the Shamrock area appears typical of undisturbed, forest-dominated environments of Southeast Alaska. The area encompasses a range of habitat types, although shoreline and mountainous types are minor in extent compared to some locations in the region. Except for estuarine and beach fringe habitat, non-forested habitat is dispersed throughout the area, enhancing habitat heterogeneity and contributing to greater biodiversity. Forested habitat dominates the area, and most of the old-growth occurs in large blocks of continuous forest, providing habitat in areas much greater than optimal patch size for many old-growth dependent wildlife. The amount of high volume old-growth forest (Volume Class 6 and 7) is relatively low, however, which may be one of the reasons that habitat conditions for Sitka black-tailed deer are low to marginal. The diversity and abundance of fish populations are a significant contribution to the area's biodiversity and provide an important resource to several species of wildlife. Exotic species typically associated with human-caused disturbance are lacking.

The Shamrock area is centrally located within the Tongass National Forest and thus occurs within the broader context of natural characteristics and land-use designations of Southeast Alaska. Although there is less mid- to high volume old-growth forest in the Shamrock area (> 8 MBF/acre) than on neighboring islands, such as Kuiu, Mitkof, Admiralty, and Prince of Wales islands, there has been very little previous harvesting of timber in the Shamrock area compared to many other areas in Southeast Alaska.

Watershed

The watersheds within the Shamrock area are similar to other watersheds in lowland areas of central Southeast Alaska. There is no evidence of widespread stream channel instability or excessive surface or stream erosion, and stream channels typically are incised because of island uplifting.

Wide channel(s) associated with estuarine deltas in the Shamrock area

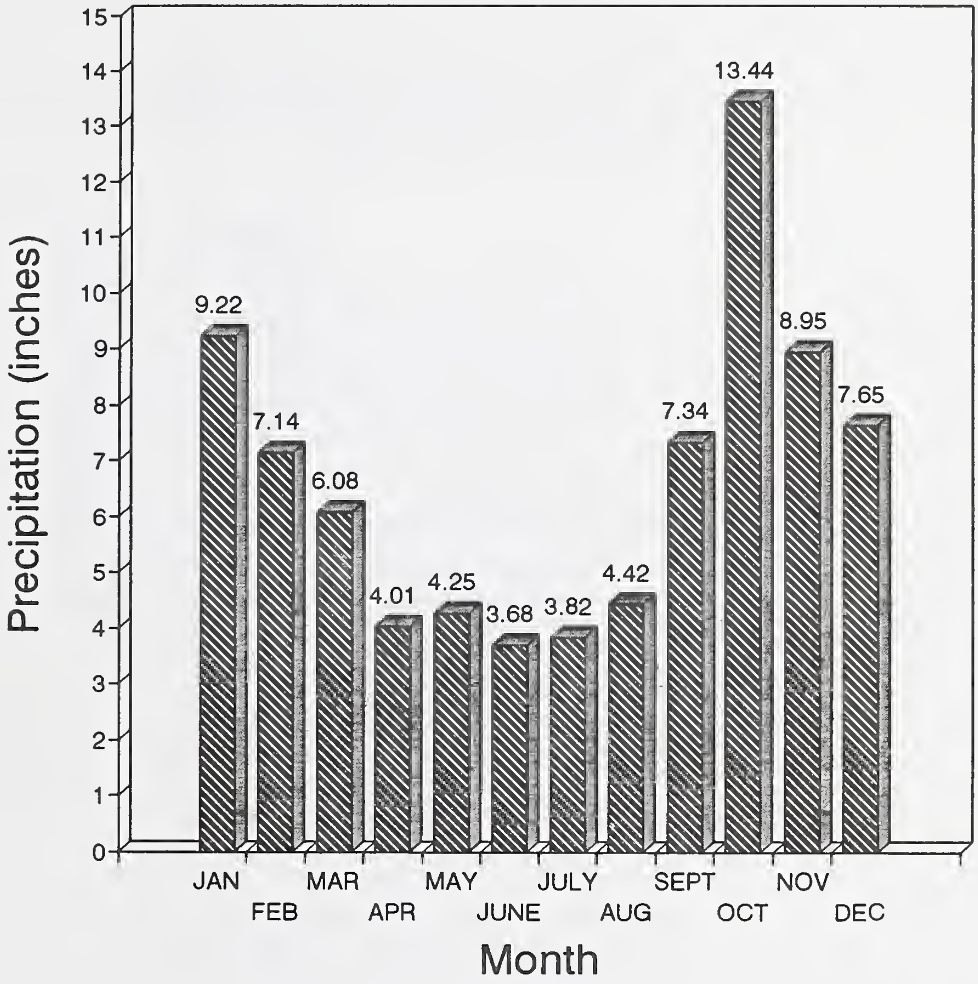
Climatic Factors Influencing Watershed

The Shamrock area has a maritime climate, as the proximity of the Pacific Ocean allows Kupreanof Island to remain cool and moist year around. There are an average of 275 cloudy days and 43 clear days per year (Harris et al., 1974). The mean daily January and July temperatures are 30° F and 55° F, respectively. The moderating effect of the ocean creates a narrow range of seasonal and daily temperature changes with daily temperature fluctuations usually less than 10° F (U.S. Dept of Commerce, 1983). The National Weather Service estimates that the Shamrock area and Kake both receive an average of 80 inches of precipitation yearly (Lamke, 1979). Since Kake and the Shamrock area have a similar annual precipitation and are only about 25 miles apart, monthly distribution of precipitation at Kake should be a close approximation of what occurs in the Shamrock area (Figure 3-4).

Stream Density

Stream density is a measure of the watershed's ability to transport precipitation from the hillslope to the channel. The higher the density, the quicker precipitation will reach the channel, and the greater the potential for hillslope and channel erosion. The average stream density for the Shamrock area is 2.12 miles/square mile (range 1.91 to 2.29 miles/square mile). The smaller watersheds that drain into Duncan Strait have an average stream density of 2.41 miles/square mile (range from 1.44 to 3.97 miles/square mile). The stream densities in the Shamrock area are typical for lowland streams in Southeast Alaska; therefore, the relative ability of these streams to transport water is average for streams in the region.

Figure 3-4
Average Monthly Precipitation for Kake, Kupreanof Island, Alaska



Source: National Weather Service.

Streamflow

There are no streamflow gages in the Shamrock area. Streamflow predictions for the Shamrock area, using the Forest Service R10 FLOWMOD model (Orsborn and Storm, 1991), indicate that watersheds will respond similarly to other lowland, rain dominated watersheds in Southeast Alaska. The majority of the discharge occurs from October to February. Although discharge is clearly correlated to precipitation, average monthly streamflow discharge is not exactly parallel to monthly precipitation, particularly in summer when soils are not always saturated. October has the greatest average monthly discharge, whereas July and August have the lowest average monthly discharges. The average annual discharge rates for watersheds within the Shamrock

area range from 75 cfs to 277 cfs (Table 3-7) for basin area ranging from 5.99 square miles to 36.22 square miles (Table 3-5). Estimated discharges resulting from 2-year storm event (i.e., bankfull flows) range from 1,557 cfs to 5,877 cfs. Estimated discharges resulting from a 100-year storm event for the six major watersheds range from 3,422 to 14,558 cfs.

Table 3-7

Average Annual, Maximum 2-Year, and Maximum 100-Year Discharges (cfs) for the Major Watersheds in the Shamrock Area, Kupreanof Island, Alaska

Watershed	Average Annual Discharge	Maximum[1] 2-year Discharge	Maximum[2] 100-Year Discharge
Keku Creek	277	5877	14558
Castle River	258	5459	13431
Tenehean Creek	227	4792	11654
Unnamed Creek 1	211	4449	10747
Big John Creek	139	2913	6775
Unnamed Creek 2	75	1557	3422

[1] Discharges estimated to result from a 2-year storm event.
[2] Discharges estimated to result from a 100-year storm event.
Source: Beedle, 1993

Comparison of watershed discharge is difficult due to the many factors involved. One method is to calculate the average annual discharge (cfs) per watershed area (square mile). The cfs rate per square mile (csm) for the Shamrock area ranges from 12.5 csm to 7.7 csm, which is similar to other watersheds in the vicinity.

Many of the large flooding events in this region occur when warm air masses associated with rain storms melt snowpacks, resulting in additional water entering the stream. These phenomena are called rain-on-snow events, and they frequently occur in areas that have temporary snowpacks. The amount of additional water entering the stream depends on the amount of rainfall, air temperature, wind speed, and the amount of water stored in the snowpack. As these variables increase, the amount of additional water entering the stream increases.

Timber harvesting can increase the amount of water entering streams, which is dependent on elevation, aspect, slope, and soil type. Furthermore, many openings throughout the watershed increase the likelihood of additional water entering many streams. This could result in a larger downstream flood.

Channel Stability

There are very few visual indicators of channel instability within the Shamrock area. The larger watersheds have a good or fair channel stability rating. Excessive bank erosion or large numbers of downed trees affecting channel movement are locally important but do not dominate any watershed. Stream channels generally consist of a single channel with only localized areas of channel braiding. Channel migration is present in alluvial fan areas where tributaries enter the main channel valley.

Even though there are few signs of channel instability, sediment transport occurs throughout the area. Large, clean bars indicating recent sediment movement are located within most basins. However there is no indication that sediment input rates exceed stream transport rates. Although high flow bank erosion is occurring within the Shamrock area, there are few signs that erosion rates are excessive.

Water Quality

Measured dissolved oxygen in the Shamrock area is acceptable for the aquatic species present. Dissolved oxygen measurements range from 5.5 ppm to 11.0 ppm. The pH values for the Shamrock area range between 5.5 and 7.0. Water quality for streams within the Shamrock area are very similar to the average values for streams in the region. Most of the streams in the Shamrock area are colored with humics leaching from muskeg areas. Streams in headwater areas are the only areas without humic coloring.

Floodplains

The direction and guidance for floodplain management is found in Executive Order 11988, the Forest Plan Revision (USDA Forest Service, 1991a), and the Soil and Water Conservation Handbook (USDA Forest Service, 1991b). The emphasis of Executive Order 11988 is to avoid adverse impacts associated with construction in, and occupancy of, floodplains.

A floodplain analysis has not been previously performed within the Shamrock area. Therefore, the 100-year floodplain of streams located in or proximal to proposed harvest units in the Shamrock area was delineated according to the guidelines for general study floodplain delineation provided in the *Water Information Management System Handbook* (USDA Forest Service, 1984b). Streams not in or proximal to harvest units were left unclassified. The floodplain classes are:

- Class A - stream segments with floodplains less than 25 ft. wide.
- Class B - stream segments with floodplains greater than 25 ft. wide but less than 100 ft. wide.
- Class C - streams with floodplains greater than 100 ft. wide.

Sixty-six Class A streams, five Class B streams, and one Class C stream were identified in or proximal to proposed harvest units. The net area of Class A floodplain identified in or proximal to proposed harvest units is approximately 73.7 acres, the net area of Class B floodplain is 28.0 acres, and the net area of Class C floodplain is 9.5 acres.

Soils

The topography of the Shamrock area has been strongly influenced by glaciers. This portion of Kupreanof Island has wide flat valley bottoms dominated by peat bogs and muskegs. A few taller ridges and mountains, to approximately 2,500 feet, protrude above the gently rolling lowlands and have a gradually sloping orientation that rapidly ascends to extremely steep slopes.

Soil Characteristics

The lowland soils are developed from thick deposits of glacial drift, which buried the pre-glacial landscape. The glacial drift is found on moderate slopes throughout the area. The predominant forest soils in the Shamrock area have developed in glacial deposits, colluvium, and residuum. Soil textures are highly variable. These soils may be very susceptible to surface erosion when disturbed and exposed to flowing water. Soils derived from glacial till have restricted drainage and typically develop peatland soils characteristic of bogs (muskegs), fens, and forested wetlands. The Shamrock area (169 square miles) has approximately 25 square miles of muskegs. These soils are the least productive for timber growth.

The steeper mountain slopes consist of soils that primarily developed in place over the bedrock, which have a variety of geological sources, including igneous, metamorphic and sedimentary. The lower concave slopes at the foot of the mountains have deeper soils developed from the accumulation of materials. These steeper mountainous slopes are generally better drained and are the most productive timber growing sites. However, these areas are highly susceptible to soil erosion and soil displacement which occurs primarily in the form of landslides, debris avalanches, and deeply incised V-notch channels.

Soil development within the Shamrock area and on Kupreanof Island has been strongly influenced by high precipitation and cold soil temperatures. Under these conditions, organic matter accumulates as a result of slow decomposition. Tree rooting is generally very shallow with most of the roots present in the surface, organic rich layers, and the upper few inches of mineral soil. This rooting zone is generally wet, acidic, and is the zone where most of the nutrient cycling occurs.

Soil Hazards

The dominant erosional process for this area is mass movement, primarily in the form of landslides. Most landslides occur during, or immediately after, periods of high rainfall when the soil is saturated. Particularly susceptible are steep slopes containing other soil hazards (e.g., V-notch channels and windthrow which can destabilize slopes and initiate landslides); soils with distinct slip-planes, such as compacted glacial till; or bedrock sloping parallel to the surface.

Most undisturbed soils in the Shamrock area are resistant to surface erosion. Thick layers of surface organic material and thick vegetative cover protects the soil from surface erosion. Vegetation, particularly tree roots, have a stabilizing effect on soils. The strength of tree roots tend to decrease significantly four to seven years after the tree is cut. This decrease in soil holding capability results in an increased likelihood of soil movement on steep slopes following clearcutting (USDA Forest Service, 1991d; 1992b).

The relative risk of excessive soil erosion from timber harvesting can be rated in terms of the amount of timber harvest and road construction on hazardous soil types. The study area was described by soil hazard classes. A general stability analysis of the Shamrock area was done based on the Soil Resource Inventory of Kupreanof Island and field verification (Figure 3-5). Four soil classes (low, moderate, high, and extreme) are used to rank soil units according to their relative potential for mass movement (Table 3-8). For most of the Shamrock area, soil hazards are low to moderate, but slightly over one-fourth of the area is classified as having high to extreme soil hazards, which occur primarily on steeper slopes.

Figure 3-5. GIS Inventoried Soil Hazards within the Shamrock Area

Table 3-8
Shamrock Area - Distribution of GIS Inventoried Soil Hazard Classes

Class	Acres By Hazard Class Acres	Percent
1-Low	60,737	60%
2-Moderate	13,116	13%
3-High	22,981	23%
4-Extreme	5,082	5%
Total	101,916	100%

Source: McCullah, 1993

Minerals

There are no active mining claims within the Shamrock area according to the records of the U.S. Bureau of Land Management and the U.S. Bureau of Mines (Harris, 1993a). Review of the mineral assessment information, local geology, known mineral occurrences, and mining claims records, indicate that no specific areas of high value/high development potential, locatable mineral deposits (gold, copper, lead, etc.) have been identified within the Shamrock area. The U.S. Bureau of Land Management has stated that there is no current information indicating that the Shamrock area contains valuable leasable mineral occurrences, such as oil, gas, oil shale, some potassium and sodium-bearing minerals, geothermal resources, and coal. Salable minerals are common variety industrial minerals such as sand and gravel. These materials are locally available within the study area and these deposits include active alluvial (water deposited) sands and gravels, alluvial benches and terraces, glacial deposits, and colluvium (rock debris deposited by gravity). These materials and rock quarries may be locally valuable as road-building material for the proposed timber harvest.

Air Quality

Air quality impacts associated with logging activities are normally produced from planned burnings associated with timber operations. Extensive planned burnings associated with timber harvest in the Shamrock area are not anticipated. The only pollutant of concern is total suspended particulate matter (TSP). The principal source of TSP is fugitive emissions associated with heavy vehicle movement on unpaved road surfaces. A much less significant source is particulate emissions from vehicle exhaust (i.e., diesel engines).

The Shamrock area is governed by particulate standards of 60 $\mu m/m^3$ (annual) and ambient 150 $\mu g/m^3$ (24-hr). Additionally, the region is classified as a Class II area which establishes a particulate matter increment for allowable increases above baseline levels. The increments for particulate matter in a Class II area are an annual geometric mean of 19 $\mu g/m^3$ or a 24-hour average of 27 $\mu g/m^3$. The Shamrock vicinity is presently in compliance with these standards.

Subsistence

With the passage of the Alaska National Interest Lands Conservation Act (ANILCA), the U.S. Congress recognized the importance of subsistence resource gathering to the rural communities of Alaska. ANILCA (16 USC 31130) defines subsistence as:

> The customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; and for customary trade.

ANILCA provides for "the continuation of the opportunity for subsistence uses by rural residents of Alaska, including both Natives and non-Natives, on public lands." It also legislates that "customary and traditional" subsistence uses of renewable resources "shall be the priority consumptive uses of all such resources on the public lands of Alaska."

Effective July 1, 1990, the federal government assumed management of subsistence use of fish and wildlife resources on federal public lands. This management is regulated by the federal Subsistence Board. The taking of fish and wildlife on public lands for subsistence uses is restricted to Alaska residents of rural communities. Non-rural residents are not provided a preference for the taking of fish and wildlife on public lands within Southeast Alaska. Juneau and Ketchikan are the only communities in Southeast Alaska that have been determined to be non-rural by ANILCA and the Federal Subsistence Board.

Natural resources are a crucial and integral part of the subsistence economy of Southeast Alaska. Cash income in most Southeast rural communities is limited and intermittent; this cash income frequently is used to purchase fuel and equipment that are a part of subsistence harvest technology. Subsistence harvests often fill essential diet needs in rural communities. Nearly a third of rural households in Southeast Alaska obtain at least half their meat and fish by hunting and fishing (Holleman and Kruse, 1991). Fish and game are widely preferred sources of food among Southeast Alaska households, regardless of household income. A mixed subsistence-market economy in which subsistence harvests and cash income are complementary characterizes the economies of most of the region's rural communities.

Subsistence activities represent a major focus of life for rural residents. These activities include hunting for deer, bear, marine mammals, and birds; digging clams, catching fish and shellfish (crabs, shrimp), and harvesting other marine invertebrates; trapping furbearers; collecting firewood; collecting herring eggs; and collecting berries and edible plants and roots. Subsistence goods may be eaten, traded, given away, or made into an item of use or decoration. For example, the skins from brown bear or fur from the marten or sea otter may be used for regalia used in ceremony and dance.

The act of gathering subsistence resources is also an important cultural aspect reflecting deeply held attitudes, values, and beliefs. Some traditional foods are not available through any means other than subsistence, and often the occasions for gathering wild foods and edible plants are social events. Historical patterns of movement, such as the annual cycle of dispersal into small family groups at summer

fishing camps and then to larger gatherings at protected winter villages, are also linked to the tradition of subsistence gathering.

Sharing of subsistence resources is important not only among households within communities, but also with extended families and friends in other areas. This includes sharing with those households unable to participate in the harvest of resources. Because some communities have access to resources not found in other communities, sharing of subsistence resources occurs among communities as well as residents.

Average per capita income may or may not indicate the importance of subsistence to a community. While individuals of low income may have a greater dependence on subsistence gathering, individuals with a higher income may simply be in a position to have a more comfortable lifestyle because they combine their subsistence activities with their ability to purchase goods. Higher income does not deter an individual from gathering resources and sharing those with friends and family (Kruse and Muth, 1990). Findings from the Tongass Resource Use Cooperative Survey (TRUCS), which assessed subsistence use of natural resources by residents of 30 Southeast Alaska communities, indicate that "members of the highest income group have the highest mean harvest of subsistence resources" (Kruse and Muth, 1990).

Historical Tlingit Clan Hunting Boundaries

Based on work conducted by Goldschmidt and Haas (1946) it appears that the spatial patterns of Native communities that existed in the mid-nineteenth century are similar to current patterns. As reported by Betts (1992), territorial possession of Kupreanof Island was at one time divided by two Tlingit tribes (kwans), the Kakekwan and the Stikinekwan (Appendix Figure C-1). The eastern half of Kupreanof Island was controlled by the Stikinekwan and the western portion controlled by the Kakekwan. These early subsistence users gathered a wide variety of natural resources including: halibut, salmon, berries, herbs, roots, bark, fish eggs, herring, invertebrates (sea urchins, gumboots, and sea cucumbers), various shellfish (clams, mussels, crabs), seaweed, birds and bird eggs, and land and sea mammals. Community subsistence use maps, produced as part of the TRUCS report, indicate that similar usage patterns are still in existence today.

Subsistence Uses

Communities with Subsistence Use

After reviewing the TRUCS data (Holleman and Kruse, 1991) and community use reports by ADF&G for the vicinity of Kupreanof Island, the following communities were selected for identifying subsistence use in the Shamrock area: Petersburg, Wrangell, Kake, Port Protection, and Point Baker. All are designated as rural, meaning their residents are entitled to the opportunity subsistence use as defined by ANILCA. These communities were selected based on their proximity to and their historic or present subsistence use of the Shamrock area.

Important Subsistence Use Areas

The beach fringe throughout the Shamrock area has been identified as a sensitive area for subsistence resource gathering. Coast or beach fringe is defined as the area of land within a 500 ft slope distance inland from the shoreline. Based on the TRUCS maps, the important use areas may be located from 3 to 6 miles from the coastline.

All five of the review communities have identified traditional deer hunting areas along the coast of Kupreanof Island, from Duncan Canal to Kake (Appendix Figures C-2 through C-5). Both the sport and subsistence deer hunting season has been closed on

Kupreanof Island since 1975 due to low deer numbers. The decline in the deer population is most widely attributed to a series of events starting with Alaska statehood. With statehood, the legal bag limit on deer was raised from two bucks only, to four or five deer of either sex. In 1970 the bounty was removed on wolves and trapping pressure ceased. As a result of the management shift, the wolf population increased on Kupreanof Island. These two factors combined with several heavy snowfall winters (1968-69 and 1970-71) cumulated in the subsequent dramatic decline of deer on the island by 1973.

Duncan Canal has been identified as the most widely used area for the hunting and gathering of subsistence resources by the residents of Petersburg, Wrangell, and Point Baker. These communities use the area extensively for the collection of marine invertebrates, hunting of waterfowl, and fishing for both non-commercial salmon and other finfish. Rocky Pass, Sumner Strait, Big John Bay, Totem Bay, Keku Strait, Castle River basin, and Tunehean Creek are all listed as areas that are used for subsistence harvest by residents of the review communities.

Subsistence Use in the Shamrock Area

The geographic extent of subsistence use of the Shamrock area for deer, marine mammals, marine invertebrates, and salmon for all communities combined indicates that both historic and present day subsistence uses are occurring in the Shamrock area. The data are based on interviews with probability samples of households in 30 Southeast Alaska communities conducted in 1988 (Kruse and Frazier, 1988).

Community-Specific Subsistence Use

The following community-specific descriptions are primarily based on four sets of material: community technical reports produced by Division of Subsistence, ADF&G; ADF&G Southeast Alaska community resource use profiles (1989); reports summarizing the results of the TRUCS data including ADF&G (1989), Kruse and Frazier (1988), Kruse and Muth (1990); and Forest Service Draft EIS Southeast Chichagof (1992). All figures referred to are based on TRUCS data from a sampling of households; therefore it is possible that the actual amounts harvested were either higher or lower than reported by sample households.

The demographic data of communities identified as using the Shamrock area provide a context for the description of subsistence (Table 3-9). The pounds of edible subsistence harvested per capita by community, and the percent of total household food supply provided by subsistence both indicate a greater use of subsistence resources by smaller and more remote communities (Appendix Figures C-6 and C-7). The total per capita pounds of subsistence harvest by community and the percentage by type of harvest show some differences among communities in preferred harvest types (Table 3-10). Due to the closure of deer hunting in 1975, only historic use of deer hunting areas will be presented in this report. No other deer harvest data for the Shamrock area are currently available.

Kake

Kake is located on the northwest coast of Kupreanof Island about five miles by land from the Shamrock area. Seventy percent of the population is Native. Tlingit Indians built villages and fishing camps in the Kake area in the early 1700s. During the 1800s these villages were consolidated at the present site of Kake. Since then, the

Table 3-9
Demographic Data on Communities Identified as Using the Shamrock Area

Review Communities	1990 Population	Percent of Population that is Native	1987 Per Capita Income
Point Baker	39	2	$6,212
Kake	700	73	$9,057
Petersburg/City of Kupreanof	3,230	10	$12,602
Wrangell	2,479	20	$11,989
Port Protection	62	4	$5,912

Source: Tongass Resource Use Cooperative Survey
University of Alaska, 1988
U.S. Forest Service, Southeast Chichagof DEIS

Table 3-10
Total Per Capita Subsistence Harvest by Percent of Harvest Type

	% of Total Deer	% of Total Salmon	% of Total Finfish	% of Total Other Mammals	% of Total Invertebrates	% of Total Other	Harvest Per Capita (lbs)
Point Baker	27	26	19	9	14	5	345
Kake	24	22	21	15	9	8	160
Petersburg	22	23	22	9	17	6	203
Wrangell	13	18	26	15	25	3	164
Port Protection	13	36	29	2	15	5	311

Source: Tongass Resource Use Cooperative Survey
University of Alaska, 1988
Southeast Chichagof DEIS

community has developed an economy based largely on the commercial fishing industry. A school and a store were built in 1891, and a cannery in 1912. A cold storage facility built in 1980 is still in operation. Logging began in the 1940s and continues to provide some employment opportunities for Kake residents. Most of the logging in recent years has taken place on lands owned by the Kake Tribal Corporation. Kake's major employment sectors are fishing and fish processing, transportation, communication, and education services. Employment is highly seasonal. Much of Kake's population depends on subsistence hunting and fishing to supplement the wages from seasonal employment.

In 1987, the community harvested a total of 160 pounds (lbs) per capita of subsistence resources. Per capita subsistence harvest consisted of 35 lbs of salmon, 39 lbs of deer, 34 lbs of other finfish, 24 lbs of other mammals, 14 lbs of invertebrates, and 13 lbs of

other resources (ADF&G, 1992). Deer constituted 24 percent of the subsistence harvest. According to the TRUCS data, subsistence harvest provides just over 20 percent of the household food supply for Kake residents.

A study of harvest and use of fish and wildlife by Kake residents indicates a high degree of conformity between contemporary use areas and traditional deer hunting territories of the Kake Tlingit (Firman and Bosworth, 1990). Kake hunters travel an average of 28 miles to their most reliable deer hunting areas. The majority of Kake's deer harvest comes from Wildlife Analysis Areas (WAA) 3939 and 3940 at the southern portion of Admiralty Island, although traditional Kake hunters used the coastal region of the Shamrock area extensively before closure in 1975. No data are currently available for deer harvest by WAA prior to 1987. As part of the TRUCS study, maps showing subsistence resource harvest and the intensity of use by residents of Kake were developed (Appendix Figures C-3, and C-8 through C-11).

Petersburg

Petersburg is situated on the northwest shore of Mitkof Island at the north end of Wrangell Narrows, approximately 25 miles by water from the Shamrock area. It was founded by Norwegian Peter Buschmann in 1899 and incorporated in 1906. More Norwegians followed and settled into a Scandinavian-style community. Petersburg grew around a cannery, and the site quickly became a center for fishing, fish processing, and transportation. Except for a slight decline in the 1950s, continual growth has occurred in Petersburg to its current population of 3,207 persons. Petersburg's main economic sector is seafood processing and manufacturing; government is the second largest employer. Other economic sectors include retail trade, construction, timber, and tourism.

Fishing boats docked in Petersburg harbor

Local subsistence resource use includes deer, moose, salmon, finfish, waterfowl, clams, crabs, and berries. The annual per capita harvest of subsistence resources in 1987 was 203 lbs per capita consisting of 45 lbs of deer, 19 lbs of other mammals, 46 lbs of salmon, 45 lbs of finfish, 35 lbs of invertebrates, and 12 lbs of other resources (ADF&G, 1992). Subsistence harvest provides just over 30 percent of the household food supply for Petersburg residents.

The beach fringe and adjacent inland areas along Duncan Canal, and around the southern tip of Kupreanof Island to Keku Strait are important historic deer hunting areas. The Castle River and large portions of Duncan Canal are used extensively by the residents of Petersburg for the harvest of both non-commercial salmon and other finfish. Duncan Canal is also used for the collection of marine invertebrates and the hunting of waterfowl. Historic and present day use for subsistence harvest were produced as part of the TRUCS study (Appendix Figures C-2, and C-8 through C-11).

Point Baker

Point Baker is located on the northwestern tip of Prince of Wales Island, approximately 15 miles from the southern boundary of the Shamrock area. Point Baker received its name in 1793 from Captain George Vancouver, who named it after the second Lieutenant on his ship "The Discovery." Native settlement of the area at that time was already established. Tlingits used fish camps at Point Baker to participate in both customary trade and subsistence fishing. Commercial fishing began in the early 1900s, when the area was used as the site of a floating fish packer. The 1990 population was 39 persons (Table 3-9).

In the 1990s, the Point Baker economy continues to be based upon fishing. The majority of the fishermen are hand trollers, although a few are power trollers and gillnetters. Besides commercial fishing, other economic enterprises include a bar, a restaurant, a grocery store, laundry facilities, a post office, fuel sales, and gasoline and diesel sales on a floating dock.

Point Baker is not an incorporated city or within any other local government jurisdiction. It is not part of any Native organization and has no traditional council. Residents of Point Baker are members of the Sumner Strait Fish and Game Advisory Council. They have expressed a strong interest in protecting local community fishing and subsistence rights.

Subsistence provides over 50 percent of the household food supply for Point Baker residents, placing the community among the Southeast Alaska communities with the highest use of natural resources. Residents recorded the highest annual harvest of subsistence per capita in 1987 at 345 lbs (Kruse and Muth, 1990). Per capita subsistence harvest consisted of 93 lbs of deer, 31 lbs of other mammals, 90 lbs of salmon, 65 lbs of other finfish, 48 lbs of invertebrates, and 17 lbs of other natural resources (ADF&G, 1992). Deer comprised 27 percent of the Point Baker total subsistence harvest for 1989, the largest percentage of the five review communities. Harvest data from the ADF&G show that most of Point Baker's deer harvest during the year of 1987 through 1990 occurred on the northwest corner of Prince of Wales Island. Maps of historic and present day subsistence use areas were produced as part of the TRUCS study (Appendix Figures C-8 through C-11).

Port Protection

Port Protection is located on the northwestern tip of Prince of Wales Island, approximately 15 miles from the southern most boundary of the Shamrock area. Port Protection was also named by Captain George Vancouver in 1793. It remained unsettled until the 1930s when a man named Jackson lost a wooden wheel from his boat and was forced to go ashore. He came to be known as "Wooden Wheel Johnson," and the cove at Port Protection (Wooden Wheel Cove) was named after this incident.

In the 1950s a warehouse was built with an eventual plan of creating a shrimp cannery. The cannery was never realized, and the building now stands empty. During the 1970s homesites in Port Protection were acquired by new residents under the state of Alaska land disposal programs. Although the area around Port Protection and Point Baker was hunted and fished by Tlingit people, Native settlements have not been locally documented. The population of Port Protection was predominantly non-Native in the 1980s.

The 62 residents of Port Protection, like those in Point Baker, rely heavily on subsistence harvest as part of the local economy. Port Protection recorded the second highest level of subsistence use per capita of the five review communities at 311 lbs. Per capita subsistence harvest consisted of 40 lbs of deer, 112 lbs of salmon, 6 lbs of other mammals, 90 lbs of other finfish, 47 lbs of invertebrates, and 16 lbs of other resources (ADF&G, 1992). Subsistence harvest provides more than 40 percent of the household food supply for Port Protection residents. Harvest data from ADF&G indicate that most of the Port Protection deer harvest occurs in or near the same area as the residents of Point Baker (Appendix Figure C-5).

Wrangell

Wrangell, located in the east-central portion of Southeast Alaska, is on the northern tip of Wrangell Island, about seven miles from the mouth of the Stikine River and approximately 35 miles from the Shamrock area. Wrangell began as an important Tlingit site primarily because of its proximity to the Stikine River. Wrangell clans held a monopoly of trading rights along the Stikine. The flags of three nations (England, Russia, and the United States) have flown over this community. In the late 19th century, Wrangell become a supply center for gold miners and prospectors during the gold rush era. Timber, fishing, and fish processing now dominate Wrangell's economy. The 1990 population is reported as 2,479 persons.

Wrangell residents hunt deer, bear, moose, and waterfowl; fish for salmon, halibut, and other finfish; and gather shellfish and berries. The annual harvest of subsistence resources was 164 lbs per capita in 1987. Per capita subsistence harvest consisted of 21 lbs of deer, 24 lbs of other mammals, 30 lbs of salmon, 43 lbs of other finfish, 41 lbs of invertebrates, and 5 lbs of other resources (ADF&G, 1992). Subsistence provides 23 percent of the household food supply for Wrangell residents (TRUCS).

Harvest data from ADF&G indicate that the majority of Wrangell residents harvest deer on the northeast side of Prince of Wales Island and on the small islands between Wrangell and Mitkof Island, with no reported historic use of the Shamrock area for deer harvest. TRUCS maps do show extensive use of Duncan Canal for the collection of marine invertebrates and the hunting of waterfowl, however. Maps showing the

areas most widely used for subsistence harvest by residents of Wrangell were produced as part of the TRUCS study (Appendix Figures C-8 through C-11).

Summary

The communities of Point Baker, Port Protection, Kake, Petersburg, and Wrangell were determined to be those most likely to harvest subsistence resources from the Shamrock area. All five communities are designated rural, which gives residents the right to gather resources for subsistence use as specified by ANILCA. As the TRUCS reports indicate, the opportunity to harvest subsistence resources is an important part of the cultural make-up of many Southeast Alaskan residents.

Many of the community residents use the Shamrock area for the harvest of deer, moose, waterfowl, marine mammals, marine invertebrates, and fishing for both salmon and other finfish. The areas of Duncan Canal, Rocky Pass, Keku Strait, Big John Bay, and the Castle River basin have historically and are presently used extensively for the harvest of subsistence resources by residents of the review communities.

Cultural Resources

Cultural resources include evidence of past human activity, potentially dating from the earliest occupation of Southeast Alaska to the recent past. These resources may be prehistoric, historic, architectural, or archival in nature. Non-renewable cultural resources include physical remains of districts, sites, structures, buildings, and objects utilized by humans which have significance in prehistory or history. Other resources may have traditional or spiritual significance for contemporary Native Americans. Cultural resources located in the Tongass National Forest encompass a wide variety of prehistoric and historic sites and artifacts that reflect at least 10,000 years of human occupation and resource use. Information obtained through the study and analysis of these sites and objects, many of which constitute the only record of former cultural traditions, can be of importance in the reconstruction of past human responses and adaptations to environmental and social change.

The cultural chronology of Southeast Alaska remains poorly known and knowledge of the prehistory of Kupreanof Island is particularly limited. Two principal sources of cultural resource information for Kupreanof Island are *A Cultural Resource Overview of the Tongass National Forest* (Arndt et al., 1987) and *Raven's Wrinkled Foot: A Cultural Resource Overview of Kupreanof Island, Southeast Alaska* (Rabich Campbell, 1987). Arndt et al. (1987) describe the diversity of cultural resources in the Tongass National Forest and present the cultural and physical contexts and themes within which site significance can be evaluated. Rabich Campbell (1987) provides archeological and historical background information on Kupreanof Island, reviews known and potential cultural resources identified in the literature and through prior inventory efforts, and evaluates Tongass National Forest cultural resource sensitivity zones in relation to Kupreanof Island.

Prehistoric remains documented or reported on or adjacent to Kupreanof Island include villages, forts, seasonal campsites, middens, gardens, graves, fish traps, petroglyphs, caves and stone artifacts. Historic period sites include cabins, fur farms, trails, mines, canneries, salteries, and logging sites. Other cultural resources may include culturally modified trees (CMTs), sites selected by Native people under the 1971 Alaska Native Claims Settlement Act (ANCSA), and locations identified through place name studies which have cultural significance to contemporary Native people. Prior inventory efforts on the Tongass National Forest have shown that, with few

exceptions, prehistoric and historic sites are usually found below 100 ft elevation associated with present or past coastlines (USDA Forest Service, 1992b). While the potential for the occurrence of cultural resources at elevations greater than 100 ft is generally low, some types of sites--such as those associated with hunting and trapping or historic mining activity--may occur at any elevation.

Dates on the earliest cultural remains at the Ground Hog Bay 2 site on Icy Strait near Glacier Bay and at the Hidden Falls site on Baranof Island indicate occupation of Southeast Alaska by a maritime hunting people extends back approximately 10,000 years. Deglaciation of Kupreanof Island was complete by 12,400 years ago (Swanston, 1984) and the island would have been available for human occupation by 10,000 years ago. The only dated prehistoric site on Kupreanof Island is the Irish Creek Site on Keku Strait. While radiocarbon dating has shown this site to have been occupied by at least 2,200 years ago, the artifact assemblage--which contains evidence of a microblade technology--suggests the Irish Creek Site may be considerably older.

At the time of historic contact Kupreanof Island was occupied by two Tlingit groups or kwans, the Kakekwan and the Stikinekwan (Rabich Campbell, 1987). Each Tlingit kwan had its own permanent winter villages and consisted of several clans which controlled access to tangible natural resources such as salmon streams, berry patches, and offshore waters for fishing and sea mammal hunting. Clans also "owned" intangible property such as clan and personal names, songs, stories, origin myths and crests. The Kakewan, composed of at least nine clans, occupied the northwestern and western portion of Kupreanof Island. Duncan Canal and the eastern portion of the island were controlled by the Stikinekwan which included at least five clans. Rabich Campbell (1987) reports the boundary between the two territories was at Portage Bay at the north end of the island and midway between Point Barrie and Totem Bay at the south end of the island.

In the late 1700s, Russian, Spanish, French, English and American ships began exploration and trading voyages along the coast of Southeast Alaska. The earliest historical information pertaining to Kupreanof Island resulted from Vancouver's mapping of Sumner Strait and Frederick Sound in 1793 and 1794. In August 1794 a mapping party under the command of Lt. Johnstone entered Hamilton Bay near the present village of Kake. Lt. Johnstone reports observing eight unoccupied fort sites at Hamilton Bay and encountering more than a hundred Tlingit who were already in possession of firearms (Vancouver, 1984). In 1799 the Russian American Company established the first permanent Russian settlement in Southeast Alaska six miles north of present day Sitka. As a result of European contact and of rapid population decline resulting from introduced diseases, traditional Tlingit settlement patterns and culture underwent fundamental change in the early 19th century. After the establishment of permanent Russian forts and trading posts at Sitka in 1799 and at Wrangell in 1834, Tlingit groups abandoned many traditional village and subsistence sites in favor of locations where trade goods were more available.

Following the Purchase of Alaska from Russia by the United States in 1867, the fishing industry became the earliest commercial enterprise in Southeast Alaska. Commercial exploitation of Kupreanof Island began in 1897 when a saltery was established at Point Barrie at the southwest end of the island. Mining as a commercial enterprise in Southeast Alaska was stimulated by the 1897 gold strike in the Yukon Territory. Early mining activity began on Kupreanof Island in 1900 with exploratory work at the head of Duncan Canal by the Portage Mountain Mining Company. Other mining activity occurred near the head of Duncan Canal in the early

1900s, but historic mineral exploration and mining has been relatively limited on Kupreanof Island. Fox farming became a major economic endeavor in Southeast Alaska early in the 20th century. Twelve fox farms are reported to have been on or adjacent to Kupreanof Island where the first fur farms were established in 1918. Most fox farms in Southeast Alaska had been abandoned by 1945. Commercial logging began by at least 1913 on Kupreanof Island and continues to the present.

Cultural Resource Surveys

Since 1974, 33 cultural resource surveys have been undertaken at various levels of intensity on Kupreanof Island, and 29 sites have been documented (Table 3-11). The majority of these surveys have been conducted by Forest Service personnel and have ranged from cursory or reconnaissance-level surface surveys to intensive project-specific inventories with the goal of providing archeological clearance for areas of proposed ground disturbance. Detailed information about project surveys and known sites is on file at the Stikine Area Supervisor's Office. Public access to these records is generally restricted due to the sensitive nature of site locational information.

No prior cultural resource surveys have been undertaken within the Shamrock area, although three surveys associated with timber sales have been conducted immediately to the north and south of the analysis area. These surveys for the South Hamilton timber sale (Reger, 1974), the North Irish Creek timber sale (USDA Forest Service, 1977), and the Totem timber sale (Roberts, 1984a) did not identify any prehistoric or historic sites. Two additional USDA Forest Service surveys have occurred in the near vicinity of the Shamrock study area. Prior to construction of a fisheries enhancement project, Arndt (1978) conducted subsurface testing in the vicinity of several bark-stripped trees without identifying subsurface cultural material. Subsequently, an obsidian flake was found in a road cut at this location and a number of cultural resource investigations have been undertaken at the Irish Creek Site (PET-160) since its discovery in 1981 (Roberts, 1981; 1984b). A survey for a proposed recreational trail along the Castle River (Arndt, 1979) recorded an historic cabin (PET-091), but no other cultural resources were identified. In 1974 and 1975 Sealaska, the regional Native corporation, documented Native historic and Cemetery sites throughout Southeast Alaska in response to certain provisions of ANCSA legislation (Sealaska Corporation, 1975). Sealaska archaeologists investigated or attempted to locate 27 reported coastal sites on Kupreanof Island in 1975. None of the sites investigated by Sealaska were in or close to the Shamrock area.

A total of 35 Kupreanof Island sites are listed on the Alaska Heritage Resource Survey (AHRS), a statewide listing of documented cultural resources. Rabich Campbell (1987:59-66) has listed an additional 54 reported but undocumented prehistoric and historic sites not included in the AHRS files. Rabich Campbell also identifies 12 Native place names that refer to locations of cultural significance to the Tlingit. No sites are listed on the National Register of Historic Places or on the AHRS within the Shamrock area. Furthermore, no reported sites are listed within the analysis area by Rabich Campbell (1987) or Sealaska (1975). Special use permits on file at the Stikine Area Supervisor's Office indicate that at least one, and possibly two, cabins may be present within the Shamrock area, but the locations indicated are well outside areas of direct or indirect impacts from timber harvest activities.

Table 3-11
Cultural Resource Surveys on Kupreanof Island

Date	By Whom	Location	Sites Identified
1974	Reger	Tonka-Duncan	2 sites
1974	Reger	South Hamilton timber sale	none
1975	Reger	Irish and Tunehean creeks (Keku Strait area)	CMTs only
1975	Sealaska	Documentation of reported ANCSA sites	8 sites
1976	Clark	Little Duncan Bay Blowdown log transfer site	none
1976	Clark	Tonka Mountain timber sale log transfer site	none
1977	Clark	North Irish Creek timber sale	none
1978	Arndt	Twelvemile Creek recreation cabin site	1 site
1978	Arndt	Wrangell Narrows Burial (PET-109)	no new sites
1979	Arndt	Castle River recreation trail	none
1979	Arndt	Lindenberg Peninsula, north shore	2 sites
1981	Arndt	Irish Creek fisheries project	CMTs only
1980	Roberts	Kake small boat harbor	1 site
1981	Roberts	Bohemia Study Area (Portage Bay area)	5 sites
1981	Roberts	Hamilton Island airport survey	3 sites
1981	Roberts	Hamilton and Cathedral Falls creeks	none
1981	Roberts	Irish Creek fisheries project	1 site
1981	Roberts	Irish Creek fisheries project	none
1981*	Stern	Kake airport survey	1 site
1982	Roberts	Todahl timber sale (Portage Bay)	none
1982	Roberts	Kah Sheets Creek fish ladder (Duncan Canal)	none
1982	Roberts	Toncan Study Area (Lindenberg Peninsula)	3 sites
1983	Roberts	Totem Bay log transfer facilities	1 site
1984	Roberts	Totem timber sale (southwest Kupreanof)	none
1984	Roberts	Toncan timber sale (Lindenberg Peninsula)	none
1984*	Wiersum	Kake road realignment	none
1986	Roberts	Tonka Cannery (Lindenberg Peninsula)	no new sites
1989	McCallum	Tonka Mountain log transfer facility (Wrangell Narrows)	none
1990	Hardin	Lindenberg Peak Communications Site	none
1991	McCallum	Mitchell Creek fish pass (east side Duncan Canal)	none
1991	McCallum	Duncan Salt Chuck/Indian Point (Duncan Canal)	CMTs only
1992	Kauneckis	Bohemia Mountain timber sale (Portage Bay area)	1 new site
1992	Kauneckis	Portage Creek fish pass (Portage Bay)	none

Sources: Rabich Campbell 1987; Sealaska 1975; USDA Forest Service Stikine Area files
* State of Alaska Survey

Recreation

The Shamrock area offers an essentially unmodified natural setting that supports primarily primitive recreation. The area contains no developed recreation facilities. The main attractions to the area are its predominately natural landscape and abundant fish and wildlife. The analysis area contains three major river systems that provide habitat for fish and wildlife populations, which in turn support sport fishing and subsistence use both within and outside the boundaries of the area. The area also contains viewsheds that are seen by recreationists visiting, or passing through the Kupreanof Island area.

Access

The Shamrock area is located within close proximity to the towns of Petersburg, the City of Kupreanof, and Kake and is part of a larger Kupreanof Island area that serves as an important recreation destination for local residents and tourists alike. The Shamrock area itself receives little direct recreational use, however. Most of the area is confined to the interior of Kupreanof Island and is accessible only by plane or helicopter. The only shoreline within the area is to the east along Duncan Canal. A few logging roads exist in the northern portion of the area, but do not extend more than five miles into the analysis area.

Access to most of the Shamrock area is limited to boat or helicopter

Recreation Opportunities

In developing the Forest Plan Revision, the Forest Service inventoried existing recreation opportunities within the Petersburg Ranger District using the Recreation Opportunity Spectrum (ROS). The ROS provides a framework for stratifying and defining classes of outdoor recreation environments that offer different recreational opportunities and experiences (ROS Book, 1986). Eight ROS classes were identified for the Tongass National Forest: primitive I; primitive II; semi-primitive non-motorized (SPNM); semi-primitive motorized (SPM); roaded modified (RM); roaded

natural (RN); rural; and urban. Definitions for each ROS class are contained in the glossary. Five of these eight ROS classes exist in the Shamrock area (Figure 3-6, Table 3-12).

Table 3-12
Acres of National Forest Land within the Shamrock Area by Recreation Opportunity Spectrum (ROS) Class

ROS Class	Acres
Primitive I	82,622
Semi-Primitive Non-Motorized	9,468
Semi-Primitive Motorized	7,347
Roaded Modified	5,430
Roaded Natural	535

Source: DiGennaro, 1992

Primitive recreation experiences include feelings of solitude and isolation that require relatively large (> 5,000 acres), remote areas that do not contain permanent man-made features. Knowledge that the surrounding environment has not been modified by human activity is an important component of the experience. Semi-primitive non-motorized experiences also involve feelings of solitude and isolation but may occur in less remote settings closer to human development. Both experiences are defined by the distinct absence of roads and motorized equipment. Roaded modified recreation experiences are supported by roads and motorized equipment. Dominant evidence of human activity (including a heavily modified and managed landscape) are expected in roaded modified settings.

Almost 90 percent of the Shamrock area maintains ROS classifications of primitive and SPNM (Figure 3-6). These areas offer a high probability of experiencing solitude, self-reliance, and isolation from the sights and sounds of humans.

The eastern portion of the Shamrock area, along Duncan Canal, maintains an ROS classification of SPM. Although the area offers a predominately natural environment, motorized boats are commonly used in Duncan Canal, particularly for fishing (both recreational and commercial) and waterfowl hunting.

The northern portion of the area, which has recently been harvested and contains approximately two miles of dirt and gravel road, maintains ROS classifications of RM and RN. These areas offer opportunities for both non-motorized and motorized forms of recreation, including off highway vehicle (OHV) use.

Recreation Places and Sites

Recreation places represent specific geographic areas used for recreation. Recreation sites refer to specific locations used for recreation, such as recreation cabins, trails, and anchorages. The Forest Service has identified 96 existing recreation sites in the Kupreanof Island area, including 17 recreation cabins (Figure 3-7). Indian Point (where a future recreation cabin is planned) and Irish Lakes are the only recreation

Figure 3-6. Recreation Opportunity Spectrum Inventory in the Shamrock Area

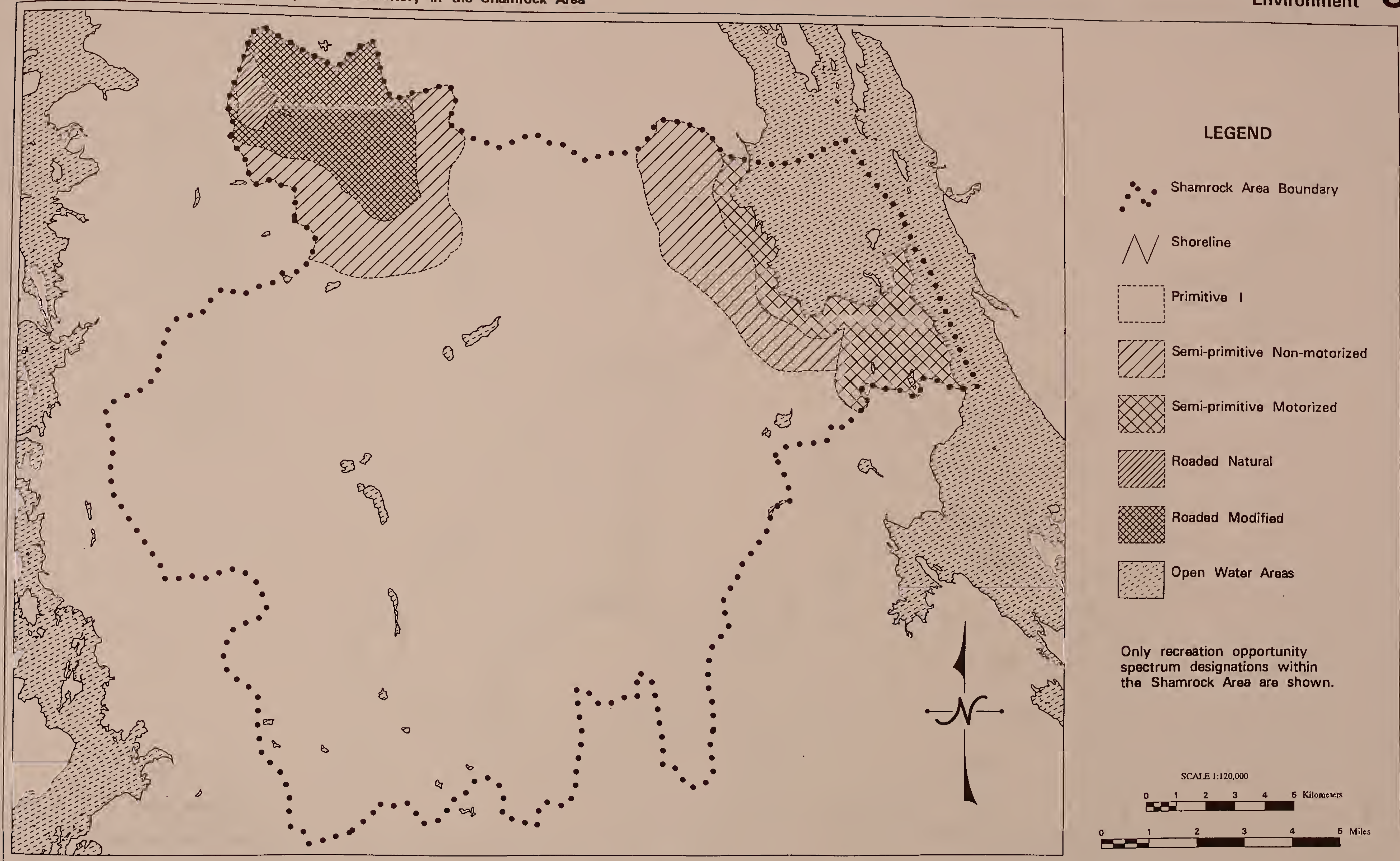


Figure 3-7. Existing Recreation Sites in the Shamrock Vicinity

places located within the Shamrock area. Potential recreation sites in the analysis area (as identified in the Forest Plan Revision) include two future trailheads near Irish Lakes.

Recreation destinations adjacent to the Shamrock area include Duncan Canal; the mouth of Castle River; Kah Sheets Lake; the Petersburg Creek - Duncan Salt Chuck Wilderness; Petersburg Creek, Lake, and trail; and Rocky Pass. There are seven recreation cabins within close proximity (less than 6 miles) to the Shamrock area including: Castle Flats, Castle River, Breiland Slough, Big John Bay, Salt Chuck East, and Devil's Elbow. These cabins accommodated approximately 870 visitors during the 1991 season (April - October).

Recreation Activities

Recreation in the Shamrock area consists primarily of dispersed, water oriented activities concentrated along the northwestern shore of Duncan Canal. Activities include both consumptive uses such as fishing and hunting, and non-consumptive uses such as sightseeing and wildlife viewing. Duncan Canal and the Castle River are popular waterfowl hunting and sport fishing areas. Although most fishing on the Castle River occurs near its mouth, which is located outside the Shamrock area, the upper portions of the river provide important fish habitat and spawning areas and thus indirectly contribute to the recreational value of the sport fishery.

Some commercial recreation activities occur on Kupreanof Island and in the waters surrounding the island, particularly Sumner Strait and Rocky Pass. These uses include guided big game hunting (particularly black bear), tour boats, small charters, and sea kayak trips that depend on the visual quality of the island. Commercial sport fishing outfitters do not typically utilize areas close to the study area. Most of the area's anglers are self-supported. Charter boat operators occasionally shuttle visitors to and from recreation cabins in the Duncan Canal area.

Wild and Scenic Rivers

The Wild and Scenic Rivers Act of 1968 established the policy that within the United States there are certain rivers of national significance which possess outstandingly remarkable values that should be preserved for the benefit and enjoyment of present and future generations. In instituting this policy, the act created a National Wild and Scenic River System and prescribed methods by which additional rivers, or river segments could be added. Currently, there are no designated Wild and Scenic Rivers within or near the Shamrock study area. The study area does however include portions of three streams determined to be "eligible" for Wild and Scenic River designation. These include: Castle River, Irish and Keku Creek, and Tunehean Creek (Figure 3-8). The process to identify and recommend these rivers was conducted as part of the Forest Plan Revision. A complete reference to the recommended rivers description, eligibility, classification, alternatives, and suitability can be found in Appendix E of the proposed Forest Plan Revision.

Eligible Rivers in the Shamrock Study Area

Castle River originates from elevations below 1,000 feet and flows into saltwater at Duncan Canal. Castle River is typical of rivers in the rolling terrain of the Kupreanof lowlands and possesses outstandingly remarkable fisheries, wildlife, and recreation values.

The stream supports populations of coho salmon, steelhead, and cutthroat trout. The Alaska Department of Fish and Game lists Castle River as one of the 19 "high quality" watersheds in Southeast Alaska. The large amount of spawning and rearing habitat available in the river is of major significance to the fisheries value.

Three Forest Service recreation cabins are located near the mouth of Castle River, 6 miles below the Shamrock study area boundary, and provide unique experiences to the visitors. Many commercial and sport fishing opportunities exist for coho salmon, steelhead, and cutthroat trout. Approximately half of the cabin use occurs during the coho salmon season by people from outside of Alaska. In addition, excellent waterfowl hunting opportunities exist which are attributable to the wildlife values.

Castle River meets the guidelines for Wild River classification for 23 miles, 17 of which are located within the Shamrock study area. The river was divided into four segments in the inventory process. Segment 1 includes the main stem from the mouth upstream for 12 miles. Only 6 miles of Segment 1 is within the Shamrock study area. This section begins 6 miles upstream from the mouth and includes the upper 6 miles of the main stem. Segments 2, 3, and 4 are the three main tributaries which flow into the main stem from the south and total eleven miles, all of which are within the Shamrock study area. Castle River was not recommended for inclusion into the National Wild and Scenic Rivers System in the Preferred Alternative of the Forest Plan Revision.

Irish and Keku Creek originate from elevations below 1000 feet on the west side of Kupreanof Island. They join for two miles before flowing into saltwater at Rocky Pass. Irish and Keku Creek are typical of rivers in the rolling terrain of the Kupreanof lowlands, and possess outstandingly remarkable fisheries and cultural values.

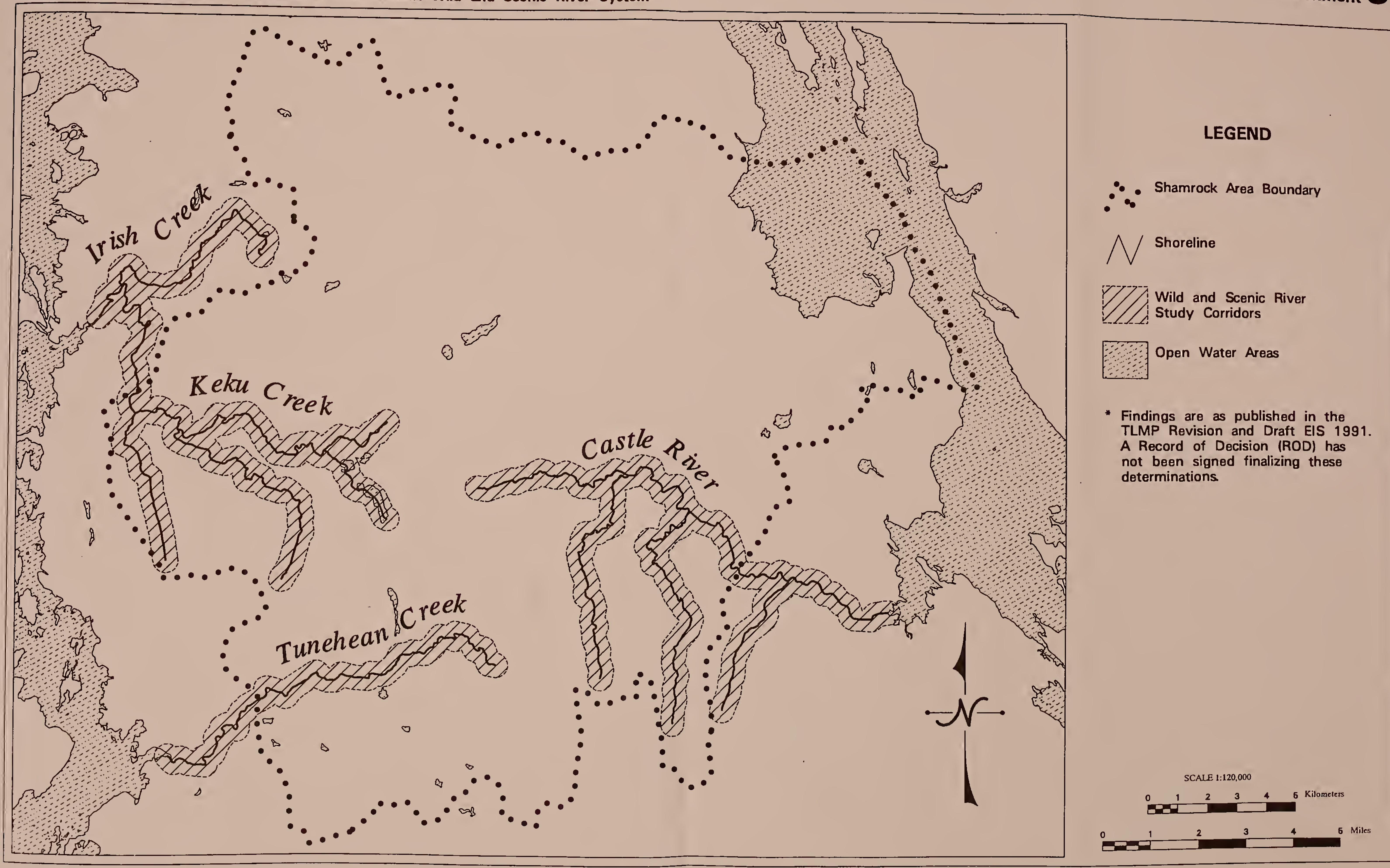
The streams have high commercial fish values for coho salmon and sport fish values for steelhead. Three major fisheries enhancement projects including two ladders exist on the stream system, which were constructed prior to the National River Inventory. Irish and Keku Creek is of regional significance for fisheries due to the size of the stream system and the potential to produce large numbers of fish. A cultural site approximately 3,000 to 3,500 years old is located near the mouth of the stream. It is of significant value because it is the oldest known cultural site on the Stikine Area. The site is located outside of the Shamrock study area.

Irish and Keku Creek meet the guidelines for Wild River classification for 17 miles, 14 of which are located within the Shamrock study area. Only one segment was defined in the inventory process, for which Keku Creek was considered as a tributary of Irish Creek. The Irish and Keku Creek was not recommended for inclusion into the National Wild and Scenic Rivers System in the Preferred Alternative of the TLMP Revision.

Tunehean Creek originates from elevations below 1000 feet and flows into saltwater in Keku Strait between Kupreanof and Kuiu Islands. Tunehean Creek is typical of rivers in the rolling terrain of the Kupreanof lowlands and possesses outstandingly remarkable fisheries value.

The stream has high commercial and sport fish values for coho salmon and steelhead. Outfitter guides take clients to Tunehean Creek for steelhead fishing, but the overall

Figure 3-8. Rivers Eligible for Inclusion in the National Wild and Scenic River System*



use of the stream for sport fishing is relatively low. The Alaska Department of Fish and Game lists this stream as a significant Dolly Varden overwintering stream and a significant steelhead stream. Tunehean Creek has outstandingly remarkable fish values of regional significance because of the variety of fish, including steelhead.

Tunehean Creek meets the guidelines for Wild River classification from its mouth upstream for 8 miles, of which the upper 5 miles are located within the Shamrock study area. Only one segment was defined in the inventory process. Tunehean Creek was not recommended for inclusion into the National Wild and Scenic Rivers System in the Preferred Alternative of the TLMP Revision.

Interim River Management

Forest Service Handbook 1909.12, Chapter 8, provides guidance for the interim river management of all eligible Wild and Scenic study rivers. The handbook direction provides for protection of the river's free-flowing characteristics, outstandingly remarkable values, and the river corridor (one-quarter mile on each side of the river). For Wild rivers, "special emphasis will be applied to visual quality outside the river corridor." Rivers are to be maintained to their "highest potential classification," until such time as they are no longer eligible for Wild and Scenic River designation. Recommended rivers in the selected alternative of the approved Forest Plan Revision will continue to be managed as eligible Wild and Scenic River candidates through the designation process. Non-recommended rivers, upon Forest Plan approval, would become available for multiple uses.

Roadless Areas

The Shamrock area contains very few existing roads. Almost 95 percent of the area is currently roadless. All areas within the Tongass National Forest that are in an unroaded and essentially undeveloped condition, but not currently designated as "wilderness," were inventoried by the Forest Service and evaluated for their wilderness potential as part of the Forest Plan Revision process. Each inventoried roadless area was identified with a name and an inventory number. Most of the Shamrock area is included in the "South Kupreanof Roadless Area" (No. 214). The area is also adjacent to the Castle Roadless Area (No. 215) and Rocky Pass Roadless Area (No. 243).

The roadless character of the Shamrock area, though an important facet of the area's environment and the primitive recreational opportunities which it provides, is a fairly common feature in the regional area. The Tongass National Forest as a whole is 91 percent roadless and the Stikine Area maintains 40 roadless areas totaling more than 2.4 million acres.

Visual Resources

Landscape Character

The Shamrock area is located in a physiographic region known as the Kupreanof Lowlands (Visual Character Types, USDA Forest Service, 1979). The region is characterized by numerous islands of rolling terrain that typically range from 300-1,500 feet in elevation with occasional hummocky mountain peaks that extend to 3,500 feet in elevation. The terrain is separated by an intricate network of short waterways, except on Kupreanof Island where long streams offer a variety of stream forms including pools, cascades, and rapids. This character type is largely covered with spruce and hemlock forest, except in low lying areas where a muskeg-shore pine association typically dominates.

The landscape character of the Shamrock area is typical of the Kupreanof Lowland physiographic region. The Visual Management System (VMS) characterizes the landscape within a physiographic region as being either distinctive, common, or having minimal variety. Approximately 74 percent of the Shamrock area has minimal landscape variety. The area is characterized by more or less uniformly rolling to nearly flat terrain with insignificant geological features and uniform vegetative patterns.

The remaining 21 percent of land in the Shamrock area has a landscape variety that is common to the physiographic region. These areas are characterized by moderately diverse rounded and hummocky terrain with moderately significant geological features such as secondary peaks and escarpments. Vegetation patterns are moderately varied in color and texture. The Shamrock area has no distinctive landscape variety. The remaining five percent of the Shamrock area is saltwater.

Viewing Locations and Seen Areas

Locations from which the Shamrock area may be viewed by visitors include Duncan Canal, Sumner Strait, Keku Strait, and several Forest Service recreation cabins near the shorelines of these waterways. In addition, there are two small plane routes that traverse Kupreanof Island that provide aerial views of the Shamrock area.

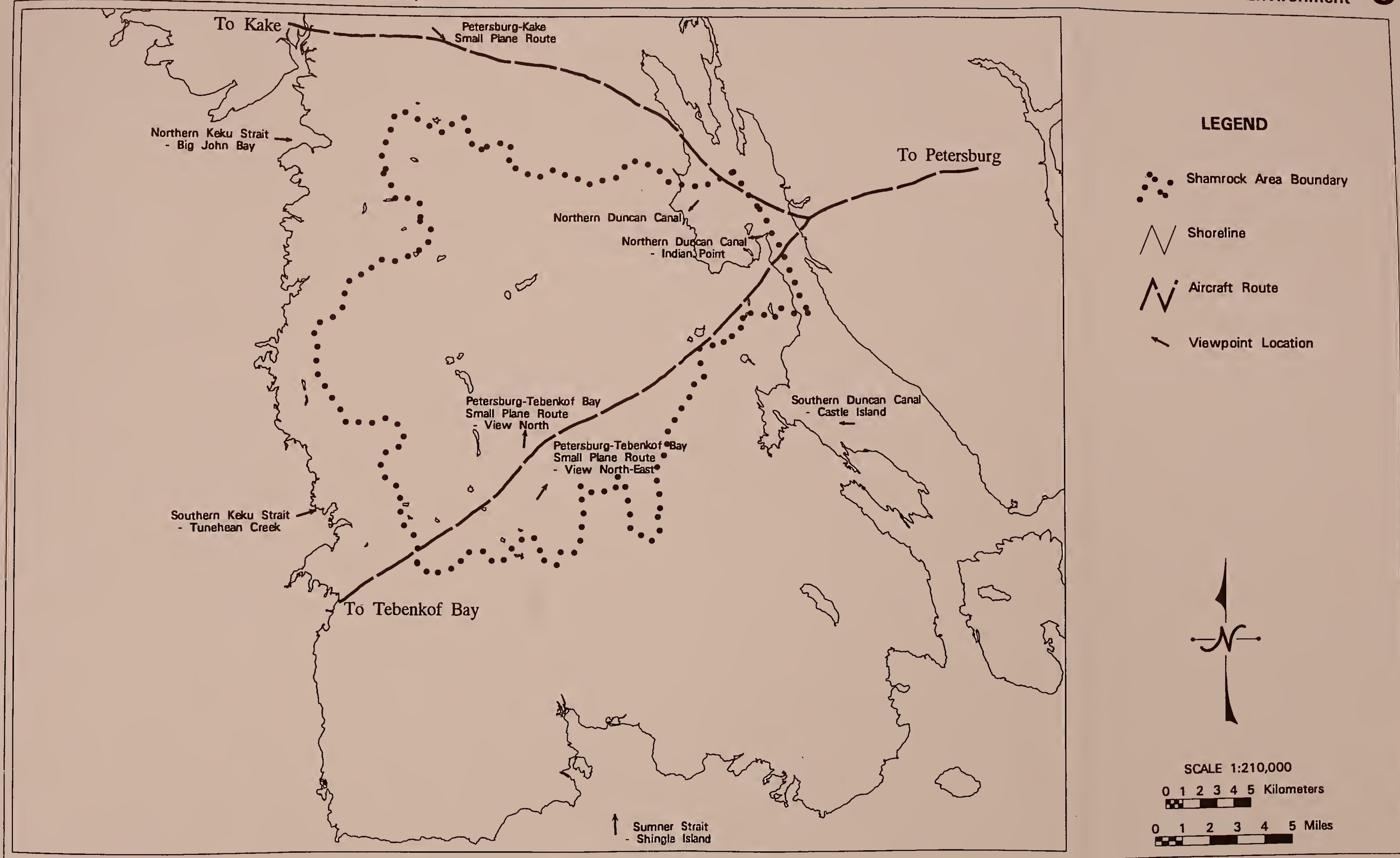
These locations are classified as having either high, medium, or low visual sensitivity based on the level of use in the area and type of user the area receives. Primary travel routes and recreation places where visitors are anticipated to have a high concern for visual quality are designated high visual sensitivity (Sensitivity Level 1). Areas that are not as heavily used and where users are less concerned with visual quality are designated as either medium or low visual sensitivity (Sensitivity Levels 2 and 3, respectively).

To the east of the Shamrock area lies Duncan Canal, a portion of which is within the boundary of the Shamrock area. Duncan Canal is designated a high visual sensitivity travel route (Sensitivity Level 1) due to the recreational and commercial boating use it receives. There are six recreation cabins along the shorelines of Duncan Canal. Three of the more popular cabins, Castle River, Castle River Flats, and Duncan Salt Chuck East (in addition to the planned Indian Point Cabin), have high visual sensitivity. The only Forest Service recreation cabin in Duncan Canal managed as Sensitivity Level 2 is Towers Arm.

Surrounding Kupreanof Island off the south and west shores are Sumner and Keku straits, respectively. Both these areas receive some commercial recreational use (tour boats, small charters, and sea kayak trips) and have been designated as medium visual sensitivity travel routes (Sensitivity Level 2). There are no cabins along the Sumner Strait shoreline. There are two recreation cabins near Sumner Strait in the Kah Sheets inlet, both of which have high visual sensitivity ratings. In Keku Straits there are two recreation cabins: Devils Elbow near the center of the strait, which has a medium visual sensitivity; and Big John Bay Cabin, which has high visual sensitivity.

The majority of the Shamrock area is not seen from Duncan Canal, Summer Strait, and Keku Strait. The area is located in the interior of Kupreanof Island and the most views of the area are screened by intervening knolls, ridges, and coniferous vegetation that borders the shoreline. In general, the Shamrock area that is seen from the saltwater boat routes that surround Kupreanof Island are confined to distant views (over three miles) of a few of the highest, outwardly-facing slopes within the area (Figures 3-9, 3-10, 3-11, 3-12).

Figure 3-9. Viewpoint Locations in the Shamrock Vicinity



Northern Duncan Canal. View southwest into the Shamrock Study Area.

Northern Duncan Canal - Indian Point. View west into the Shamrock Study Area.

Figure 3-10	Views of Kupreanof Island from Duncan Canal

Sumner Strait - Shingle Island. View north towards the Shamrock Study Area.

Figure 3-11 Views of Kupreanof Island from Duncan Canal and Summer Strait

Southern Keku Strait - Tunehean Creek. View east towards the Shamrock Study Area.

Northern Keku Strait - Big John Bay. View east into the Shamrock Study Area.

Petersburg - Kake Small Plane Route. View southeast towards the Shamrock Study Area.

Figure 3-12 Views of Kupreanof Island from Keku Strait and the Petersburg-Kake Small Plane Route

View northeast

View north

Figure 3-13 Views of Kupreanof Island from the Petersburg-Tebenkof small plane route.

In addition to the land and water viewing locations, there are two small plane routes that cross Kupreanof Island and provide expansive views of the Shamrock area on clear days. The two routes begin at Petersburg extending west through the Duncan Canal Portage. The northern small plane route veers to the north towards Kake and crosses most of Kupreanof Island 2 to 4 miles north of the Shamrock area (Figure 3-12). The southern small plane route veers south at Duncan Canal towards Tebenkof Bay and crosses the southern portion of the Shamrock area (Figures 3-13). Both plane routes are flown at elevations between 1,500 and 2,000 feet and have medium visual sensitivity (Sensitivity Level 2).

In contrast to the limited views of the Shamrock area available from the saltwater travel routes, much of the Shamrock area can be seen from the small plane routes (Figure 3-9), particularly the southern route. Most of the southern half of the Shamrock area, including Indian Point, and the Castle River and Tunehean Creek drainages, can be seen from the southern plane route. From the northern plane route, expansive views are available of the unnamed drainage and Duncan Canal at the northeast corner of the Shamrock area. Additional views of the Shamrock area from the plane route are predominantly blocked by the steep ridgeline that defines the northern boundary of the Shamrock area.

Existing Visual Condition

Existing Visual Condition (EVC) mapping describes the present on-the-ground level of visual quality of an area and is measured by five condition types which range from naturally occurring to highly disturbed landscapes. The majority of the Shamrock area, 88 percent, is in a natural condition (Type I) where only ecological change occurs. The remaining 6 percent of the area has been disturbed by timber harvest activities and road development (Type IV and V). These areas of disturbance include two small parcels located on the west shoreline of Duncan Canal between the Castle River inlet and Indian Point, and one large parcel located in the northwest corner of the Shamrock area on the north side of the Big John Bay River drainage. These areas exhibit landscape changes associated with timber harvest activities that are easily noticeable or obvious to the average forest visitor and may resemble natural patterns when viewed from a distance (Figure 3-14).

Inventory Visual Quality Objectives

The Inventory Visual Quality Objectives (VQOs) for the Shamrock area provides a benchmark for assessing visual resources, but do not incorporate other resource values such as timber, soils or wildlife. The VQOs suggest varying degrees of acceptable modification based on landscape character viewer sensitivity, and viewing distance. In areas of distinctive landscape character and high viewer interest, VQOs of retention and partial retention suggest managing for little or no visible change in the landscape. In areas of common or minimal landscape variety that are infrequently seen by forest visitors, the VQOs of modification and maximum modification allow for management activities that dominate the landscape, although they must appear as natural patterns from a distance.

The majority of the Shamrock area (77 percent) has a VQO of maximum modification (Figure 3-15). These areas are generally located within the interior of the island, have minimal landscape variety, and are not seen from the canals and straits that surround the island. However, most of these areas are seen from the southern (Tebenkof-Petersburg) small plane route.

Areas of modification represent about 12 percent of the Shamrock area and are found mainly around the perimeter of the Shamrock area. These areas tend to have greater landscape variety than the maximum modification areas, although still common to the

region, and are visually more sensitive because they can generally be seen as background (more than 3 miles) from the canals and straits that surround the island.

Another 6 percent of the area has a VQO of partial retention. The two areas of partial retention in the southern portion of the Shamrock area are angular peaks nearly 2,000 feet high that are seen as background from Sumner Strait. There are three areas of partial retention in the northeast section of the Shamrock area. Two of the areas are in the unnamed drainage and can be seen from Duncan Canal. The third area encompasses a small area of shoreline south of Indian Point. The remaining areas of partial retention are located along the northwest border of the Shamrock area where timber harvesting and road construction activities have recently occurred.

Less than 1 percent (184 acres) of the Shamrock area has a VQO of retention. This area encompasses Indian Point and the shoreline directly to the south, where the planned construction of a recreation cabin in the near future will increase the viewing opportunity in the area. The remaining 5 percent of the Shamrock area consists of water.

Visual Management Classes

Visual Management Classes (VMCs) are used in project planning to indicate the relative ease or difficulty that may be required to meet the VQOs for an area. VMCs may also indicate the type of harvest techniques to be used, and the extent of landscape architectural input required in the interdisciplinary effort. Visual Management Classes temper VQOs by incorporating VAC ratings. Figure 3-16 depicts the VMCs for the Shamrock area.

The majority of the Shamrock area is in either a Class 3 (35 percent) or 4 (54 percent) VMC. Normal timber harvest activities are acceptable under both these classifications, but shaping and spacing of clearcut units may be necessary to achieve the appearance of natural patterns when viewed as background.

The remainder of the Shamrock area is in either Class 1 or 2. These areas include some of the shoreline near Duncan Canal, and the higher peaks in the north, central, and south areas of the Shamrock area. Clearcutting in these areas should not dominate the landscape character, and lengthy rotations as well as small clearcuts should be considered.

Figure 3-14. Existing Visual Condition (EVC) for the Shamrock Area

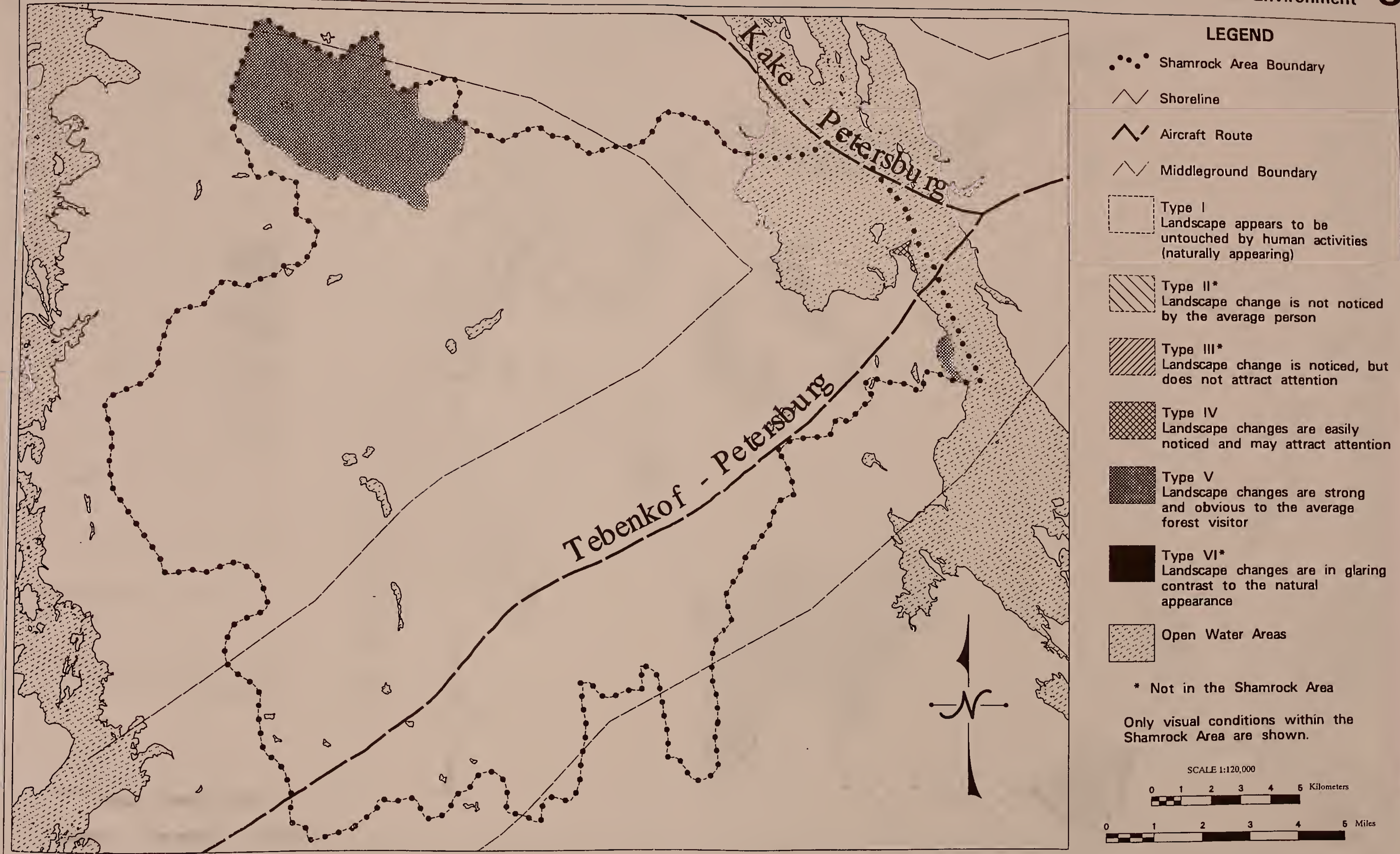
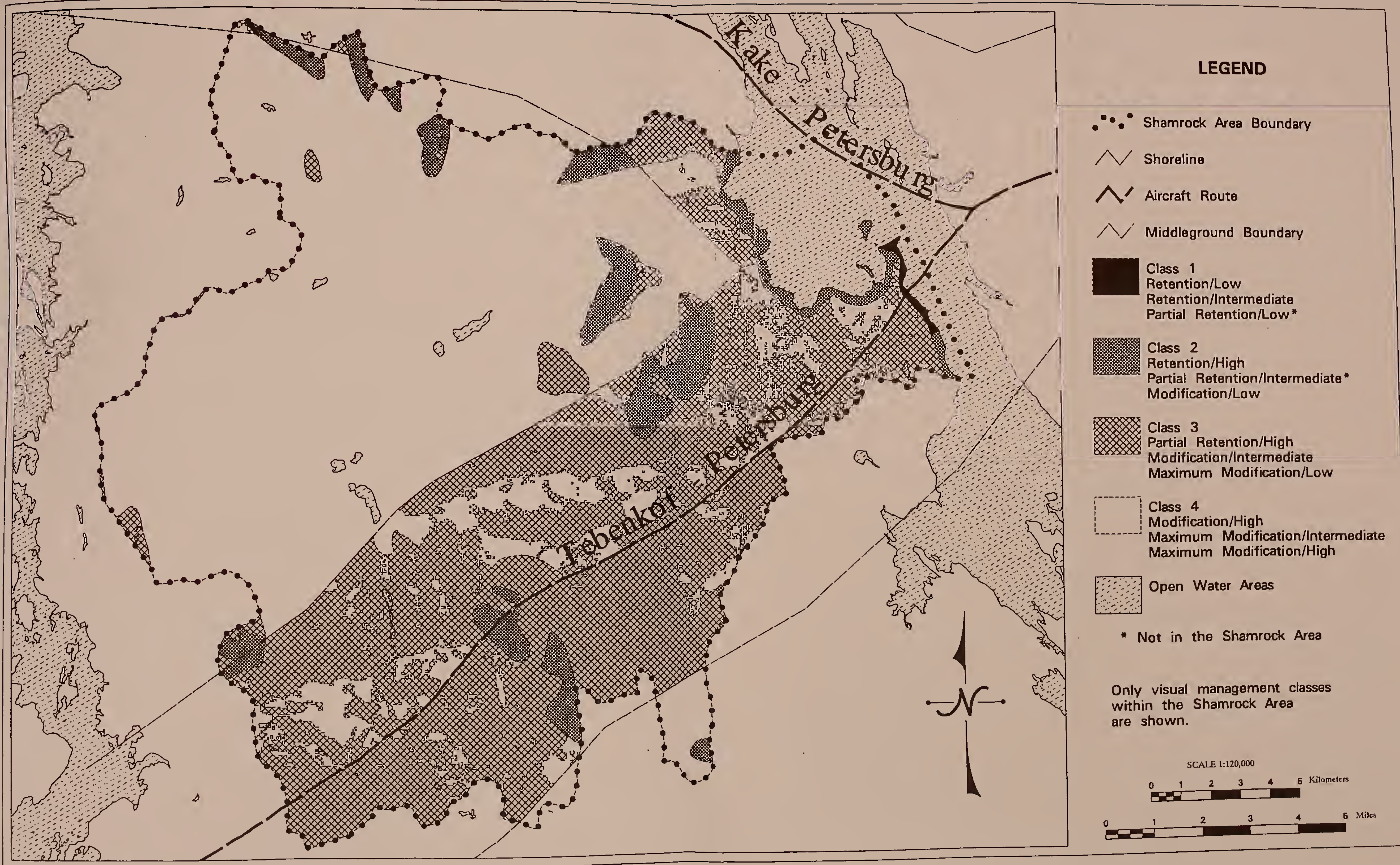
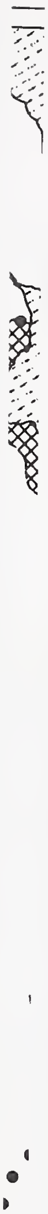


Figure 3-15. Inventoried Visual Quality Objectives (VQOs) in the Shamrock Area

Figure 3-16. Visual Management Classes (VMCs) in the Shamrock Area





Chapter 4

Environmental Consequences

Chapter 4

Environmental Consequences

Chapter 4 discusses the environmental consequences of the proposed timber harvesting in the Shamrock area. The chapter is organized by resource, following the order in Chapter 3. For each resource, an introductory paragraph provides an overview of impacts to that resource typically occurring from timber harvest and road construction, with particular reference to any major concerns raised during the scoping process. Each impact category is then addressed in detail, followed by discussion of cumulative impacts and mitigative measures. Any recommended or required monitoring and any suggested enhancement measures come at the end of the resource section. The chapter is concluded with a general discussion on other environmental considerations, including unavoidable adverse impacts, the relationship between short-term uses and long-term productivity, irreversible and irretrievable commitment of resources, and possible conflicts with plans and policies of other jurisdictions.

Transportation

New forest roads for the Shamrock harvest would be classified as either specified or temporary roads. Specified roads are developed and operated for long-term land management. These roads form the primary transportation links in the timber sale area, joining harvested areas to the LTF. Temporary roads are shorter road segments that connect harvest units and sort yards with specified roads. These roads provide short-term access, and are closed to vehicular traffic following timber removal purposes. These roaded areas eventually revert to vegetation, usually alder and spruce. See Appendix B for a summary of road descriptions, including maps, and Appendix D for the prescribed Road Management Objectives.

Road Miles

Road construction associated with timber harvest improves local transportation resources when specified roads are constructed. The miles of specified road constructed for the Shamrock timber sale would vary by action alternative with most new road miles associated with Alternative 2 (Table 4-1). No new road miles of specified road would be associated with Alternative 1, the no action alternative. The impacts of road construction and use on the other resources in the analysis area are described by resource elsewhere within this chapter.

Table 4-1
New Road Miles and Acreage by Alternative

Alternative	Specified Road Miles	Temporary Road Miles	Total Road Miles	Specified Road Acres	Temporary Road Acres	Total Road Acres
1	0	0	0	0	0	0
2	42.3	6.3	48.6	341	34	375
3	24.6	3.3	27.9	198	18	216
4	33.8	5.8	39.6	272	31	303
5	33.8	4.8	39.6	272	26	298

Road Connections

Road 6314 was originally planned to provide a major transportation link between the village of Kake and the southern end of Kupreanof Island. Due to the Forest Supervisor's decision to rescind the Decision Notice of the North Irish Timber Sale Reoffer, Road 6328 will become the major road linking the unharvested Shamrock area with the existing transportation system. Road 6328 would be constructed across Big John Valley to intersect the originally proposed alignment of Road 6314 and ultimately bisect the Shamrock area to provide access for potential timber harvest. Construction of roads for the action alternatives would provide differing opportunities to link existing and proposed road systems on Kupreanof Island. Implementation of Alternatives 2 and 4 would result in the construction of a major specified road (Road 6314). This road would traverse north and south through the Shamrock area, and join any potential future road system in the southern portion of Kupreanof Island with the Village of Kake and the Little Hamilton Bay LTF (located in the northern portion of Kupreanof Island). Road 6314 for Alternatives 3 and 5 would terminate 7 and 1.5 miles, respectively, north of the southern periphery of the Shamrock area. Implementation of these latter alternatives would not provide road access between the northern and southern portions of Kupreanof Island. The no action alternative, Alternative 1, would leave approximately 15 miles of Road 6314 unconstructed.

Log Transfer Facility

The existing Little Hamilton Bay LTF would be used to transfer logs to salt water. This LTF was reconstructed in 1983 for an A-frame or crane lift, which provides a controlled, non-violent entry of logs into the salt water. Non-violent methods of log entry, such as the one at the Little Hamilton Bay LTF, were proposed based on the assumption that greater force on log entry resulted in greater bark and debris loss (Faris and Vaughan, 1985). Presumably, the Little Hamilton Bay LTF minimizes the production of bark and debris because of this design.

The potential major effect from log transfer is the accumulation of bark and woody debris around the entry and storage site (Faris and Vaughan, 1985). Bark sloughed during transfer and storage can accumulate, cover the bottom, and smother existing habitat and sessile organisms. Water quality around or in bark accumulations could be affected to varying degrees.

The volume and area of bark deposits appears to be directly related to the amount of timber transferred at the LTF (Freese, Stone, and O'Clair; 1988). Other factors which

also could play important roles, include long-term, deep and shallow water currents; surface currents; type of transfer device and method of operation; use and location of boom logs; and bottom topography. In the absence of other uses of the same site, debris accumulation can be expected to decrease through dispersal by tidal currents, burial by sedimentation, or decomposition in place (Faris and Vaughan, 1985). Freese, Stone, and O'Clair (1988) speculated that the dispersion of bark debris is influenced by unique events such as major storms which may or may not coincide with peak tidally-induced currents.

Table 4-2 shows an estimate of the area covered by bark deposits and the volume of bark deposits by each alternative.

Table 4-2
Bark Accumulation Estimates by Alternative

Alternative	Bark Accumulation Area (Acres)	Bark Accumulation Volume (Cubic Feet)
1	0.0	0
2	1.2	34,516
3	0.8	17,248
4	1.0	23,392
5	1.0	26,223

The Little Hamilton Bay LTF is located on an estuary and is probably more sensitive to bark accumulation than LTFs located on open marine environments. Since Little Hamilton Bay is known as an important herring spawning area, there are potential adverse impacts of using the facility for the Shamrock Timber Sale, primarily if logs are transferred to salt water during an active spawning period. The estuary associated with Little Hamilton Bay covers approximately 4,160 acres. The amount of area affected by each action alternative varies between 0.8 and 1.2 acres, which accounts for less than 0.03 percent of the Little Hamilton Bay estuary.

Maintenance and Log Storage Yards

Four potential maintenance and log storage yards were identified during the analysis and are shown in Figure 4-1. Sites A and B would be used under Alternatives 2, 3, 4, and 5. Sites C and D would be used for Alternatives 2, 4, and 5.

Due to limited log storage capacity at the LTF, sites were identified where logs could be temporarily stored and sorted before transported to the water. Two of these sites (A and B) were located outside the Shamrock area along existing roads and were of sufficient size to allow for construction of the log harvesting maintenance yard if necessary. Sites C and D, located within the Shamrock area, are large enough to allow for sorting, scaling, and storing logs from separate portions of the Shamrock area.

Construction of each site would involve vegetation clearing, limited excavation, and require rock fill. The site would require an overlay of quarry rock with the top comprised of 4 inch minus to a depth of 8 inches. Each site would be sloped to allow for surface run-off to perimeter ditches and catchment basins. The surface would have

to be covered with suitable material to prevent penetration of the sub-substrata by deleterious materials (BMPs 14.4, 14.21, and 14.25).

Site A would be located 9.5 miles from the Little Hamilton Bay LTF adjacent to Road 6314 approximately 0.25 miles south of the Hamilton River Bridge. This site is situated on a large flat and covers both sides of the road within a muskeg opening in stands of non-commercial scrub timber. A storage yard at this location (10 miles north of the Shamrock area) should be large enough to handle the annual volume harvested. Area is approximately 10 to 15 acres.

Site B would be located adjacent to Road 6314, approximately 0.5 miles south of its junction with Road 6328 and 12.5 miles from the Little Hamilton LTF. This site is located approximately 6.8 miles north of the Shamrock area. The terrain in this area is comprised of large flats with muskeg and non-commercial, scrub timber stands. The site is located with a sufficient buffer to prevent pollution of adjacent watercourses. This storage yard could be constructed large enough to handle the total annual volume from the Shamrock area (10 to 15 acres) or could also be constructed to 4 to 5 acres in size to handle the annual volume from harvest units in the north third of the area (all units between Road 45801 and the north boundary of the Shamrock area). Since the 6314 road system will not be constructed as previously planned due to the decisions reached on the reoffer of the North Irish Sale, this site (B) is not as desirable from a hauling perspective.

Site C would be located adjacent to Road 6314 approximately 0.2 miles north of its junction with Road 45803 and 26.65 miles from the Little Hamilton Bay LTF. The terrain varies in slope between 0 to 7 percent and is comprised of small muskeg openings to noncommercial timber stands. This storage yard would be located on the west side of the road with a sufficient buffer between the site and the tributaries of the Upper Irish/Keku river system. A 4 to 5 acre area would be required to sort, scale, and store the annual harvest volume from units adjacent to Roads 45803 and 45806.

Site D would be located adjacent to Road 6314, approximately 0.37 miles north of its junction with Spur "A" in Unit 28 and 25.9 miles from the Little Hamilton Bay LTF. The site is situated on a large flat composed of small muskeg and non-commercial forest stands at the height of land between the Tunehean, Irish/Keku, and Castle river drainages with a level to 6 percent grade. A 4 to 5 acre area east of Road 6314 would be required to sort, scale, and store the annual harvest volume from the harvest units south of this site.

The above sites would be used intermittently for timber harvesting over the next 20 years or more. During times when there is no timber harvesting activities, these sites could be used as recreation vehicle camp sites or parking lots for fishing and subsistence users.

Cumulative Effects

The North Irish timber sale includes 4.4 miles of roads already constructed in the Shamrock area. This road mileage would not be altered by any alternative for the Shamrock EIS. Additional roads in the Shamrock area would depend on future timber sales not yet identified.

Figure 4-1. Proposed Maintenance and Log Storage Yards for Shamrock Harvest

Vegetation

The short-term and most obvious effect of timber sale activities would be the conversion of old-growth forest stands within the areas harvested into young, early successional timber stands. Alternative 2 has the highest number of harvested acres (2,702 acres), followed by Alternative 5 (1,948 acres), Alternative 4 (1,766 acres) and Alternative 3 (1,176 acres). No harvest would occur for Alternative 1, the no action alternative. Each of the proposed action alternatives would affect varying amounts of commercial and suitable forest land within the Shamrock area (Table 4-3). Commercial forest land includes those areas that can produce commercial quantities of industrial wood. Suitable forest land includes only those lands that can be regenerated successfully, logged without causing irreversible soil damage, and are not withdrawn from timber production by statute or administrative action.

Table 4-3
Comparison of Harvest by Action Alternative in the Shamrock Area

Alternative	VCU	Proposed Harvest (Acres)	Suitable Forest Land (%)[1]	Commercial Forest Land (%)[2]	Land Area Harvested (%)[3]
2	429	1,197	9.5	5.4	2.2
	436	1,016	12.7	8.4	4.8
	438	489	9.9	4.7	1.8
	Totals	**2,702**	**10.6**	**6.0**	**2.7**
3	429	709	5.6	3.2	1.3
	436	146	1.8	1.2	0.7
	438	321	6.5	3.1	1.2
	Totals	**1,176**	**4.6**	**2.6**	**1.2**
4	429	1,185	9.4	5.3	2.2
	436	260	3.3	2.1	1.2
	438	321	6.5	3.1	1.2
	Totals	**1,766**	**6.9**	**3.9**	**1.7**
5	429	1,113	8.8	5.0	2.1
	436	517	6.5	4.3	2.4
	438	568	10.6	5.4	2.0
	Totals	**1,948**	**7.6**	**4.3**	**1.9**

[1] Suitable forest land totals 25,586 acres.
[2] Commercial forest land totals 44,993 acres, which includes Volume Classes 1-3 in addition to Volume Classes 4-7.
[3] Total land area not covered by water equals 101,916 acres.

The following discussion of environmental effects on the vegetative land base is from concerns and issues expressed by the public, interdisciplinary team for the Shamrock EIS, and foresters. These concerns and issues have been grouped into six separate categories:

- harvest treatments;
- volume class distribution;
- plant succession;
- long-term productivity, growth, and forest health;
- TES plants; and
- wetlands.

Harvest Treatments

The selection of appropriate silvicultural treatments is a concern from the public, the interdisciplinary team, and foresters. Foresters are concerned that timber can be removed efficiently while regenerating a new stand and maintaining long-term productivity, which is discussed in this section. Much of the public concern over timber harvesting is related to the landscape effects of clearcutting, which are discussed in the visuals, watershed, soils, wildlife, fisheries, and biodiversity sections of this chapter. In addition, industry members of the public are concerned that the silvicultural treatments used will be cost-effective; the results of the economic analysis are discussed in the economics section.

During the analysis of this project, silvicultural treatments appropriate for Southeast Alaska were considered. Both even and uneven-aged silvicultural systems are approved for use in the Shamrock area depending upon specific resource needs (USDA Forest Service, 1983). Even-aged management is recommended when the management objective is to maintain fast growing, mistletoe-free stands of mixed species. Uneven-aged management is recommended on sites where significant windthrow is not anticipated, and the management goal does not include high timber

Recently clearcut spruce/hemlock forest on Kupreanof Island

yields of mixed species, or where other resource concerns require this kind of stand structure.

Clearcutting is an even-aged silvicultural system where all merchantable trees are removed from a given area or harvest unit. This method is recommended and is considered appropriate for use in the western hemlock-Sitka spruce forest type (USDA Forest Service, 1983; Harris and Johnson, 1973). Characteristics of this cutting method include:

- logging costs are lower than for partial cutting;
- solar radiation raises soil temperature accelerating decomposition of organic matter and releasing nutrients that temporarily increase site productivity (Ruth and Harris, 1979);
- natural regeneration is assumed adequate to provide a fully stocked stand;
- Sitka spruce is favored due to destruction of advance hemlock regeneration and creation of mineral seedbed favorable to spruce regeneration; and
- no residual overstory trees infected with dwarf mistletoe remain to reinfect hemlock during regeneration.

National Forest Management Act regulations provide that 100 acres is the maximum size of created openings allowed for the western hemlock-Sitka spruce forest type of coastal Alaska unless excepted under certain conditions (USDA Forest Service, 1983). For the Shamrock harvest, six units are proposed that exceed 100 acres (Table 4-4). Justifications for exceeding the 100 acre size limitation are shown in Chapter 2 and in the respective unit summaries.

Uneven-aged systems, or partial cutting in the form of small group selection, is generally recommended to meet specific needs of nontimber resources such as visuals, wildlife, recreation, or biodiversity. Group selection cuts create small one-half to two acre openings, closely approximating the type of small-scale disturbance commonly found in Southeast Alaska ecosystems (Harris, 1989). Other characteristics of group selection cuts include:

Table 4-4
Clearcut Harvest Units Exceeding 100 Acres by Alternative

Harvest Unit	Area (Acres)	Alt. 2	Alt. 3	Alt. 4	Alt.5
13	102	X	X	X	X
28	177	X		X	X
31	109	X			
32	156	X			
36	114	X		X	X
61	113	X			X
NI9	110	X	X	X	X

Source: Seaberg, 1993

- a continuous tree cover is maintained to reduce visual change and potential soil erosion, and to maintain deer habitat;
- natural regeneration is adequate with western hemlock favored due to more shade and less soil disturbance;
- there is increased risk of dwarf mistletoe infection in the understory if adjacent overstory is infected;
- logging costs are estimated to be 25 to 50 percent higher than for clearcutting;
- there is potential for increased risk of windthrow in residual timber stand;
- shade-intolerant plant species such as alder and salmonberry are not favored;
- additional roads may need to be constructed and additional areas harvested to produce an equivalent clearcut timber volume; and
- subsequent entries to remove remaining trees increase the risk of soil damage and logging damage to residual trees.

Green tree retention is a form of partial cutting used in conjunction with clearcutting. This cutting method involves leaving selected trees uncut to mitigate visual, wildlife, and biodiversity concerns. Use of green tree retention is basically limited to shovel-logged areas, but is also proposed for several units with cable logging. Characteristics of this cutting method are similar to group selection and include:

- the visual size of clearcut openings is reduced by leaving standing trees;
- residual green trees provide a structural legacy of the old-growth forest;
- residual green trees provide a source of potential snags for cavity-nesting birds and potential supply of large downed woody material for other wildlife species;
- logging costs are estimated to be 15 to 25 percent higher than for clearcutting;
- there is an increased risk of windthrow, although this can be mitigated by selecting relatively windfirm leave trees;
- mistletoe reinfection is mitigated by leaving green trees that are infection-free;
- a seed source of selected species can be maintained for the regenerated stand; and
- the volume contained in these trees would likely never be harvested or utilized in future entries.

The advantages and disadvantages of partial cuts were carefully considered for each harvest unit. It was concluded that most units should be clearcut except in situations where partial cutting was feasible and would provide substantial benefit to other resources, such as wildlife, visual, and silvicultural resources. Clearcutting would account for 94 percent of the acres harvested under Alternative 2, 99 percent of the acres in Alternative 3, and 95 percent of the acres in Alternatives 4 and 5. Table 4-5 shows the harvest units where partial cutting prescriptions would be employed, and Table 4-6 shows the number of acres in each cutting method by alternative. Within Units 7, 15, 23, 28, 29, 36, 55, 61, and 81 specified areas were identified for green tree retention. One harvest unit, Unit 40, would have group selection cuts, where approximately one-third of the standing volume would be removed in one-half to two acre patch harvests.

Table 4-5
Harvest Units with Partial Cutting Prescriptions

Harvest Unit	Area[1] (Acres)	Prescription	Alt. 2	Alt. 3	Alt. 4	Alt. 5
7	13	Green Tree Retention	X	X	X	X
15	12	Green Tree Retention	X			X
23	17	Green Tree Retention	X			X
28	9	Green Tree Retention	X		X	X
29	26	Green Tree Retention	X			
36	29	Green Tree Retention	X		X	X
40	43	Group Selection	X		X	X
55	5	Green Tree Retention	X			
61	27	Green Tree Retention	X			X
81	29	Green Tree Retention	X			

Source: Seaberg, 1993
[1] Area of harvest units with green tree retention prescriptions is for that portion of unit with green tree retention prescription.

Table 4-6
Area Harvested by Cutting Method by Action Alternative

Alternative	VCU	Clearcut Acres (%)	Partial Cutting Acres (%)
2	429	1,132 (95)	65 (5)
	436	898 (88)	118 (12)
	438	462 (95)	27 (5)
	Total	**2,492 (92)**	**210 (8)**
3	429	696 (98)	13 (2)
	436	146 (100)	0 (0)
	438	321 (100)	0 (0)
	Total	**1,163 (99)**	**13 (1)**
4	429	1,120 (94)	65 (6)
	436	231 (89)	29 (11)
	438	321 (100)	0 (0)
	Total	**1,672 (95)**	**94 (5)**
5	429	1,048 (94)	65 (6)
	436	411 (88)	58 (12)
	438	340 (93)	27 (7)
	Total	**1,799 (92)**	**150 (8)**

Source: Seaberg, 1993

Proportion of Harvest Acres by Volume Class Strata

During the scoping process, concern was raised that higher volume timber stands would be logged first without regard to future entries. Selectively removing timber from the high volume stands could result in a disproportionate amount of area in low volume stands in the area. This situation could make future entries uneconomical or decrease the amount of habitat available in high volume timber stands.

There was little difference (< 0.2 percent) among alternatives relative to high volume stands (Volume Classes 6 and 7)(Table 4-7). The original unharvested Shamrock areas are based on the amount of timber available for harvest prior to the North Irish Timber Sale. Alternative 1 - no action displays the effect of harvest that has occurred from the North Irish Timber Sale.

The proportion of Volume Classes 6 and 7 remaining after harvest would increase slightly under all alternatives.

Table 4-7
Area and Proportion of Volume Classes 6 and 7 Harvested for Each Alternative

Alternative	Area Harvested (Acres)	Area Unharvested (Acres)	Area of Volume Classes 6 and 7 Harvested (Acres)	Area of Volume Classes 6 and 7 Unharvested (Acres)	Proportion of Unharvested Area in Vol. Classes 6 and 7 (%)	Increase in Proportion of Vol. Classes 6 and 7 (%)
Unharvested Shamrock Area	0	44,377	0	3,399	7.66	---
Alternative 1	267[1]	44,111	0	3,399	7.70	0.04
Alternative 2	2,969	41,518	213	3,186	7.67	0.01
Alternative 3	1,443	43,044	31	3,368	7.82	0.16
Alternative 4	2,033	42,454	94	3,305	7.78	0.12
Alternative 5	3,216	42,271	150	3,249	7.68	0.02

[1] Alternative 1 includes 267 acres harvested in the North Irish Timber Sale.

Plant Succession

Nearly all (98.7 percent) of the Shamrock commercial forest land is in old-growth stands. The physical structure of the old-growth understory and overstory is considered the most diverse of all stages of succession (Alaback, 1982). Each stand renews itself through small windthrow events, creating small openings in which new trees and shrubs regenerate. The major timber species are western hemlock, Sitka spruce, and Alaska-cedar (also known as yellow-cedar). Under Alternative 1, the Shamrock area would continue in this self-perpetuating stage.

The most obvious effect of harvest on vegetation in the Shamrock area would be the conversion of old-growth forest stands into young, early successional timber stands. Second-growth stands would show less variability in tree diameter and height than the old-growth stands that they replace. Stands proposed for clearcut harvest in all action alternatives are expected to regenerate naturally. Hand-planting of nursery grown seedlings would be prescribed for stands which cannot be certified as adequately stocked within five years of harvest, as required by the National Forest Management Act.

During the first five years following clearcut harvest, there would be a rapid establishment of tree species, shrubs, forbs, and grasses. Increased temperature and sunlight would stimulate the breakdown of organic material, increasing nutrient availability and vegetation growth. Species such as Alaska blueberry and red huckleberry would increase in productivity due to vigorous sprouting from underground stems (Alaback, 1984). Huckleberry and salmonberry would respond positively to the removal of the tree canopy. The mineral seed bed produced by ground disturbance in clearcuts favors Sitka spruce, as well as non-commercial species such as salmonberry and alder. Mosses, lichens, herbs, and shrubs that thrive best in the shade and protection of a mature overstory would be reduced in vigor and competitive ability. Removal of overstory would make adjacent stands more

susceptible to windthrow. Understory development along the edge of adjacent timber stands would increase due to additional sunlight.

There would be a difference in the initial vegetation response in areas partially cut. Since Sitka spruce is the least shade tolerant of the major timber species, it would likely comprise a smaller proportion of the regenerated stand, when compared to clearcut areas. Western hemlock has a higher shade tolerance and would be more likely to survive under the shade of an overhead canopy. Western hemlock has the ability to develop seedlings on logs and other organic material, which allows this species to dominate in areas with little ground disturbance.

Between years 5 and 20, Sitka spruce and western hemlock seedlings would grow into a young forest with an estimated 3,000 stems per acre (USDA Forest Service, 1992b). Understory production of woody stemmed species is at its highest at this stage, especially in *Vaccinium*-dominated sites. Larger dead materials from the original stand begin to decompose, and the stand edge stabilizes, resulting in less windthrow. At this age these stands would be considered for precommercial thinning.

Typical wetland vegetation in Southeast Alaska

Between the ages of 20 and 80 years, trees would grow rapidly, averaging about one foot in height per year (Zaborske, 1991). Tree crowns would close forming a dense canopy, and causing rapid reduction in understory biomass and an increase in dense moss. Stands could develop a two layered canopy with western hemlock in the lower tier. Canopy closure would occur more slowly in precommercially thinned sites. At age 80, growth would begin to slow as competition between trees increases.

In years 80 to 100, the stand would become mature. At age 100, tree heights would range from 90 to 120 feet and diameters range from 10 to 15 inches, depending upon site productivity. Some trees would die, while others would become dominant in size. Wood decay and defect would become a more significant component of the standing timber volume. Moss would continue to dominate the understory, except in places where the canopy has been opened to allow sufficient sunlight for herbaceous plants. This would be the normal rotation age, when a regenerated stand would be considered for harvest. For those stands managed for longer rotations, the above structural characteristics would continue into the later stages of the stand (120 to 140 years) with continued slow growth and occasional openings in the canopy.

Productivity and Forest Health

Stand productivity and forest health are concerns of foresters. Overmature stands within the Shamrock area are at an equilibrium where mortality and growth are in balance. They are beyond the age of maximum average annual growth. These conditions would be maintained throughout the analysis area under Alternative 1, and in unharvested old-growth stands under the action alternatives. All action alternatives would convert unmanaged, overmature stands to more productive second-growth stands that are more productive for wood fiber. Even-aged stands maintain growth at a higher level than mature and overmature stands (Harris and Farr, 1974).

The open conditions created in clearcuts allow both Sitka spruce and western hemlock to regenerate rapidly. Even-aged stands usually contain from 10 to 75 percent spruce depending on the soil type and the age of the stand. Spruce is estimated to account for 50 percent of standing volume in managed, second-growth stands 75 to 100 years after harvest (Taylor, 1934). Favoring Sitka spruce during precommercial thinning could increase the spruce component an additional 10 percent.

Precommercial thinning of harvested stands would increase the amount of usable fiber, as growth would be concentrated on fewer stems. Merchantable size logs would be produced in a shorter time period, allowing the possibility of reducing the rotation age. Preliminary information (Alaback, 1984) suggests that thinnings may enhance understory productivity in young (pre-canopy closure) stands, but there is no evidence that subsequent thinnings would increase diversity of understory vegetation found in old-growth forests.

Younger stands created by harvesting would be relatively disease-free when compared to the overmature stands. Wood decay and defect would be less than in old-growth timber stands. Although timber harvest would not eliminate dwarf mistletoe, the effect of this pathogen on tree growth is not expected to be critical to growth in young second-growth stands (Shaw, 1982). Precommercial thinning favoring removal of infected trees would reduce the amount of dwarf mistletoe in these stands.

The cause of Alaska-cedar decline is unknown (Hennon et al., 1990), but this condition is concentrated in boggy areas, generally outside proposed harvest units. Based on existing research, timber harvesting does not seem to effect the spread of the factor or disease that causes the decline.

Higher total yield per acre is expected in second-growth stands than in mature and overmature stands. Log quality would be lower in second growth stands, due to the higher proportion of volume in small diameter trees and the smaller proportion of knot-free wood. At the same time, there would be less wood decay in the second-growth stand.

TES Plants

Documentation of project impacts on TES plant species is required by the Forest Plan and the Endangered Species Act of 1973. No plant species that are listed as threatened or endangered by the USFWS (50 CFR part 17; February 21, 1990) or as sensitive by the State of Alaska or Region 10 of the Forest Service are known to occur in the analysis area. Thus no impacts to TES plants are anticipated by any of the alternatives considered for the proposed Shamrock timber sale.

Menzies' spiraea (*Spiraea douglasii* subsp. *menziesii*) is considered rare in Southeast Alaska by the Alaska Natural Heritage Program (ANHP) and was found in the Shamrock area. Although they have no official protection under any jurisdiction, populations in the Shamrock area are at the northern end of the range for this species and should be protected whenever reasonably possible. Since it occurs primarily in riparian communities, buffers around lakes and streams required by the Forest Wide Standards and Guidelines (USDA Forest Service, 1991d) will protect this species in most instances. Consequently, the only impacts of action alternatives would be restricted to some locations where roads cross streams.

Wetlands

Timber harvest and road construction can affect the chemical, biological, and physical integrity of wetlands. The impacts from timber harvest are generally short-term due to the rapid regeneration of vegetation anticipated in the logged areas and the limited amount of forested wetland included in the proposed harvest units (Table 4-8). In contrast, new road construction results in long-term impacts, and roads would be constructed through muskegs and mixed forest-muskeg wetlands, which are recognized as some of the more functionally important wetlands in the Shamrock area (Table 4-9). Once transformed into roads, these areas would not readily revert to wetlands.

For the Shamrock area, the types of impacts that would occur to wetlands from implementation of the action alternatives are (1) erosion of exposed mineral soils from wetlands located in harvest units, (2) short-term loss of wetland vegetation in harvest units, (3) loss of floodflow modulation capability, (4) loss of sediment retention capacity, and (5) loss of wetland wildlife habitat. These impacts are described below with their relative importance in the Shamrock area.

Table 4-8
Area of Forested Wetland (Acres) within Proposed Harvest Units, by Alternative

Wetland Type	Total Acres of Wetland in Shamrock Area	Alternative 1	2	3	4	5
Forested	4,644	0	152	68	101	100
Mixed Forest-Muskeg	41,033	0	157	72	102	104
TOTAL	**45,677**	**0**	**309**	**140**	**203**	**204**

Table 4-9
Area of Wetland (Acres) Altered by Road Construction, by Action Alternative

	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Wetland Type	T[1]	P[2]	T	P	T	P	T	P
Forest	10.5	5.5	6.7	4.2	10.2	5.3	10.0	5.2
Muskeg	2.2	1.0	1.7	0.9	2.0	1.0	1.7	0.8
Mixed Muskeg - Forest	52.2	26.0	24.4	16.6	50.7	25.2	42.9	21.2
TOTAL	**64.9**	**32.5**	**32.8**	**21.7**	**62.9**	**31.5**	**54.6**	**27.2**

[1] T is acres of wetland altered due to temporary road construction. Wetland functions will recover as road reverts to vegetation after use during the Shamrock Timber Sale.
[2] P is acres of wetland permanently lost due to placement of permanent roads.

Erosion

Erosion of soils from clearcut forested wetlands would not be a substantial or long-term impact. In Southeast Alaska the rapid regeneration of vegetation in clearcuts minimizes soil loss following timber harvest. Furthermore, only 152 acres of forested wetland occur within the proposed timber harvest units.

Construction and persistence of road surfaces, cut banks, and borrow pits would also cause erosion of exposed soils from wetlands. In addition, mass movement events would become more likely due to road building activities such as blasting, excavating slope support, overloading slopes by side casting, and directing and accumulating water. The potential for erosion of wetland soil due to road construction would be greatest for Alternative 2 which has the greatest amount of roads to be constructed in wetland areas (Table 4-9).

Loss of Wetland Vegetation

Loss of wetland vegetation would be a short-term impact on forested wetlands located within proposed harvest units. The loss is not a serious overall effect on the Shamrock wetlands because a maximum of only six percent of the total land area within harvest units is classified as forested wetland (Tables 4-3, 4-8).

There would be both temporary and permanent losses of wetland vegetation in the areas where roads would be constructed (Table 4-9). Implementation of Alternative 2 would result in the greatest permanent loss of wetland vegetation from road building. Alternative 4 would result in slightly lower impacts from roads. Alternative 3 would have the least impacts of the action alternatives.

Increased Sediment Loading Into Wetlands

Increased sediment loading could occur in wetlands located directly below harvest units, especially harvest units on steep slopes. This, in turn, could have impacts in adjacent streams previously buffered by wetlands. However, sediment input from harvest units would quickly decrease and eventually stop following regeneration of

vegetation. Specified roads would be a greater source of sediments because, unlike harvest areas, they would not revegetate and sediments would continue to erode.

Sediment retention is the removal of inorganic sediment from surface waters. The Shamrock wetland types most important in accomplishing this function are the muskegs located in stream valleys and near tributaries below sites prone to landslides or mass wasting. Since none of the action alternatives alter more than 0.1 acre of low lying muskeg wetland, a minimal amount of muskeg area occurring on floodplains would be lost from the Shamrock area.

Loss of Floodflow Alteration Capability

Floodflow modulation is the reduction in magnitude of peak flows and the delay in release of water to downslope areas immediately after storms. Because the forested wetlands occurring on floodplains are more likely than the muskegs to come into contact with floodwaters in the Shamrock area, these areas are generally the most valuable for slowing floodwaters. Harvesting timber in wetlands in floodplain areas would temporarily reduce the floodflow alteration capability of these areas. The effects of this loss, however, would be limited to a short time period due to the rapid regeneration of vegetation following timber harvest. Effects of timber harvest on local hydrology are discussed more fully in the watershed section of this chapter.

None of the action alternatives would disturb substantial amounts of floodplain forested wetlands. Alternative 2, which would alter the greatest amount of these wetlands, would impact less than one acre of forested wetland occurring on floodplains as a result of both road construction and timber harvest.

Cumulative Effects

Most of the Shamrock area, as well as most of Kupreanof Island, continues to be designated by the Forest Plan Revision for intensive development to maintain and promote industrial wood production. Even-aged timber management, with clearcutting as the primary harvest method, would be expected to continue on these lands. Lands near Duncan Canal and within the immediate vicinity of Irish Lakes are designated in the Forest Plan Revision for semi-primitive recreation, and are to be maintained in natural appearing settings. Timber harvest on these lands would be restricted to salvage operations only.

Over the long-term, the entire suitable commercial forest land base would be available for timber harvesting. Under the proposed management direction in the Draft Revision of TLMP, this conversion process would occur over the next 150 years. Over the next 50 years approximately 11,000 acres are scheduled to be harvested and converted into discrete even-aged stands. This would account for 42 percent of the suitable forest land, 24 percent of the commercial forest land, and 10 percent of the Shamrock land area. The actual timing and occurrence of future harvests would be dependent on management direction, budgeting, and site-specific project analysis and decisions.

Within the next decade, other timber sales proposed near Shamrock area include the Clover and Douglas timber sales. The only previous timber harvesting near the Shamrock area has occurred in VCU 429 during the North Irish Timber Sale contract.

Under the current listing of TES plants by the USFWS, no cumulative effects on TES plant species should occur in the Shamrock area due to timber harvesting. When the ANHP and Forest Service publish lists of officially recognized sensitive species, cumulative effects on TES plants from proposed timber sales in Shamrock area should

be re-addressed. Cumulative effects on Menzies' spiraea should not occur as long as buffers are maintained along all Class I and II streams and all lakes.

Mitigative Measures and Monitoring

Harvest units are expected to regenerate naturally. Units would be surveyed within 5 years of logging to determine if these areas are adequately stocked with young growing conifers. At that time Forest Service silviculturists would determine if hand planting would be necessary. Regeneration of Alaska-cedar is a concern for harvest units with plant associations in the western hemlock-Alaska-cedar, mixed conifer, and mountain hemlock plant series. Those areas would be closely monitored to determine if adequate stocking of Alaska-cedar is obtained. If adequate stocking is not obtained, then sites would be hand-planted with Alaska-cedar.

Precommercial thinning would be recommended for the most productive units. The acres that would be thinned would depend on budget availability and resource needs. The following acreage is estimated for precommercial thinning by alternative: Alternative 2 - 596 acres; Alternative 3 - 223 acres; Alternative 4 - 398 acres; and Alternative 5 - 472 acres. Where precommercial thinning is prescribed stocking would be reduced to between 200 to 300 trees per acre, leaving a species composition of approximately equal numbers of Sitka spruce and western hemlock intermixed with some Alaska-cedar (USDA Forest Service, 1992b).

Since impacts to TES species are not anticipated to occur, no mitigative measures for TES plants are required for timber harvesting or road construction activities in the Shamrock area. Although, Menzies' spiraea could be present at road and stream crossings, disturbance to riparian areas will be minimized as a general road construction practice.

Disturbance to wetlands located on steep slopes has been minimized to limit loss of soil from these wetlands. Stabilization of disturbed areas following timber harvest will be accomplished by leaving slash on the ground and by ensuring that vegetation rapidly recolonizes the harvested areas. Revegetation is not expected to be a problem in any of the proposed harvest units. Proper road design minimizes road related erosion from wetlands. Erosion control structures such as water bars and sedimentation basins will mitigate the erosion effects of roads on wetlands. In addition, where wetlands are adjacent to roads or harvest units, disturbance should not extend beyond the road right-of-ways and harvest units. Under circumstances where timber harvest does occur on erosion-prone slopes above wetlands, buffer strips left above wetlands and below clearcuts will reduce sediment loading into the wetlands.

Loss of floodflow alteration capability in wetlands will be mitigated through avoidance of timber harvest in floodplain wetlands. In situations where avoidance is impossible, natural regeneration of wetland vegetation will in a relatively short time, mitigate the temporary loss of floodflow alteration capability.

Wildlife

Timber harvest activities proposed for the Shamrock area would alter the existing wildlife resources primarily through the alteration of old-growth forested habitat to young successional stages. Habitats and habitat utilization by wildlife species would change over time as natural revegetation occurs within harvested areas. The complex interactions among ecological succession, wildlife habitats, and wildlife species are discussed in terms of the direct, indirect, and cumulative effects of timber resource

utilization within the analysis area. The relationship of wildlife to biodiversity and subsistence is discussed in later sections of this chapter.

To remain internally consistent within this EIS and to remain consistent with other Forest Service land management plans, habitat analyses with respect to wildlife in the Shamrock area have been evaluated on a VCU basis. Alaska Department of Fish and Game (ADF&G) utilizes Wildlife Analysis Areas (WAAs) as their method of delineating Alaskan ecosystems and for presenting analyses of the potential effects upon wildlife (Reed, 1992). VCU 429 composes about 70 percent of WAA 5130 and VCUs 436 and 438 comprise about 40 percent of WAA 5133.

Direct and Indirect Effects

Direct effects of proposed timber harvest and road building activities potentially include changes in old-growth and aquatic habitat types, shifts in wildlife species and populations, changes in wildlife habitat capability, and direct effects to special-status species (threatened, endangered, candidate, sensitive, or other special-concern species). Indirect effects may include changes in prey populations, loss of a critical habitat component, or any other change that would alter a species' decision to utilize its preferred habitats. The USFWS expressed concern about the affects of the Shamrock harvest on a variety of wildlife species (Stieglitz, 1992). Impacts to these species are discussed below in sections on aquatic habitats (waterfowl and shorebirds), MIS (bald eagle), and TES species (marbled murrelet, northern goshawk, and Vancouver Canada goose).

Changes in Old-Growth Habitat

Depending upon the selected action alternative, timber harvest activities would change 1,176 to 2,702 acres of predominantly old-growth forested habitats in the Shamrock area. Timber harvest activities are not, however, irretrievable commitments of resources because, if left unmanaged, ecological succession should eventually return developed areas to old-growth conditions.

From 28 to 49 miles of roadways would be constructed under the various harvest alternatives. As currently configured, roadway construction would remove or alter 216 to 375 acres of vegetated habitat, plus additional acreage for 16 to 33 rock pit excavations. Roadway corridors may facilitate overland travel for some wildlife species and hinder travel for others, for example, during heavy snows. New roads also increase the likelihood for collisions between vehicles and wildlife, increase the potential for illegal hunting and poaching, and increase hunter access into formerly remote locations.

Log storage yards and maintenance facilities needed to support timber harvest would remove vegetated habitat and require excavated material from proposed rock pit quarries for ground cover. Activities at these facilities would likely prove a local nuisance for nearby wildlife. Species such as black bear could be attracted to these areas.

The greatest alteration in wildlife habitat would result from implementation of Alternative 2, followed by Alternatives 5, 4, 3, and 1 in descending order. Alternative 2 affects approximately 50 percent more acreage and requires approximately 30 percent more roadway miles than Alternatives 4 and 5, which are similar to each other (in terms of affected area). Alternative 3 affects approximately two-thirds the acreage and roadway miles of Alternatives 4 and 5. No changes in wildlife habitat would occur for Alternative 1.

Effects on Aquatic Habitats and Associated Species

Shamrock area activities would not cause alteration of wildlife habitat near the estuarine fringe of the project area. The proposed harvest unit nearest the coastline along Duncan Canal is greater than six miles inland. There are no proposed harvest units within fringe habitats adjacent to aquatic resources for Class I and II streams; buffer zones around these aquatic resources have been mandated by TTRA and the Forest Plan. Consequently waterfowl, shorebirds, and other species associated with estuarine and aquatic habitats should not be affected by harvest activities.

However, roadways constructed to link harvest units for the Shamrock timber sale would require up to 106 crossings of stream corridors, and use methods ranging from overcrossings containing 48-inch culverts up through 40-foot bridges. Effects on Shamrock area aquatic resources are detailed in other sections. Roadway crossings of aquatic fringe habitats have the potential to impact water dependent species such as amphibians, waterfowl, beaver, shrews and other animal species that utilize streams as travel corridors or to forage or nest. Assuming that streams are not permanently damaged and BMPs are followed, wildlife should recolonize and utilize the stream corridors once construction is complete and sediment has settled.

Shifts in Wildlife Species and Populations

Although the areal extent of wildlife habitat alteration within the entire Shamrock area is small and dispersed, wildlife utilization of harvest units would change. Clearcuts in close-canopied forested habitat would be unfavorable to the approximately 100 species associated with old-growth habitat (Suring et al., 1992), approximately one-third of which occur exclusively in old-growth habitats. Effects on wildlife would actually be larger in extent than the harvest units and roadways themselves because of changes to the microenvironment of forest adjacent to cleared habitat. The cleared and recently revegetated harvest units would increase the available habitat for those species that are not as dependent upon forested habitat. Shifts in wildlife species composition within specific harvest unit locations are unlikely to cause measurable changes in the overall species use of the Shamrock area. The relative levels of shift in species are based upon the comparative amounts of affected habitat for each action alternative.

Changes in Habitat Capability for MIS

Changes in habitat capability for Management Indicator Species (MIS) were assessed using habitat capability models supplied by the Forest Service. Use of these models was requested by various organizations during the public scoping process for the Shamrock EIS (Reed, 1992; Knight, 1992). As suggested by ADF&G, the latest versions of habitat capability models were employed. These models were polygon-based and specifically tailored and calibrated to the Shamrock area.

Habitat capability models were utilized for five Shamrock area MIS: Sitka black-tailed deer, marten, black bear, river otter, and bald eagle. The models predict the amount and suitability of wildlife habitat in the Shamrock area and permit estimation of habitat suitability changes under various management alternatives. Modeling assumptions include: (1) implementation of an action alternative would convert existing habitat to clearcut or roaded characteristics for the first 25 years after harvest; (2) all harvests and road construction occur over a short time-frame, (3) clearcut habitat is potentially utilized by wildlife species and can therefore be given some suitability index ($HSI \geq 0$); (4) roadways are considered exclusively as "unsuitable"

wildlife habitat (HSI=0); and (5) harvest units possess second-growth characteristics from year 25 through the end of the rotation. Thus, acreage of a particular habitat suitability category may increase or decrease, depending upon the suitability of clearcut and second-growth habitat for the particular MIS. The HSI categories are defined as: "good" ($0.7<HSI\leq1$), "average" ($0.3<HSI\leq 0.7$), "below-average" ($0<HSI\leq0.3$), and "unsuitable" (HSI=0). (Use of the terms "good," "average," "below-average," and "unsuitable" in this discussion refers specifically to these numeric HSI categories.)

Wolf tracks on shore of Kupreanof Island

The predicted shifts in habitat suitability can be used to estimate changes in the carrying capacity of the Shamrock area to support MIS populations. Carrying capacity is calculated for each HSI category as a function of the habitat suitability index (HSI), maximum population density in optimal habitat, and habitat area. Predicted carrying capacities for HSI categories are then summed to derive an aggregate carrying capacity for the region (VCU or Shamrock area). It is important to realize that estimated carrying capacities are not actual numbers of animals, but are appropriately used in this analysis to compare the effects of alternatives.

Estimates of carrying capacities and alterations in habitat suitabilities are provided for the first 25 years after harvest, i.e., as long as harvested sites retain a general "clearcut" character, and for second-growth forest (25 years to 100 years). Inclusion of second-growth analyses allows evaluation of effects through the life of the rotation.

Sitka Black-Tailed Deer

Highest-value deer winter range ("average" suitability; 8,947 acres) is only about 8 percent of the Shamrock area. Greater than 90 percent of the analysis area is "below-average" or "unsuitable" (Table 4-10). There is no "good" winter range. Action alternatives would result in a net loss of 179 to 504 acres of "average" habitat and an

increase in "unsuitable" deer winter range by 216 to 399 acres (Table 4-10). There would be a varied effect on the "below-average" habitat depending on the VCU and management alternative. Timber harvest activities would predominantly replace existing forested habitat with clearcut patches, and the habitat suitability of unthinned clearcuts as deer winter range is "below-average." Second-growth habitat (year 25 post-harvest through the end of the rotation) is also in the "below-average" HSI category. Thus, there is no shift in acreage within these categories throughout the life of the project, but the specific suitability of the acreage is different between clearcut and second-growth. For example, a particular area might have a suitability index of 0.15 as a clearcut, but when the area progresses to second-growth, the suitability index drops to 0.05. There is no change in the amount of "below-average" habitat in this example, but the specific suitability does change, which will affect carrying capacity (discussed in a later paragraph).

Table 4-10
Modeled Post-Harvest Habitat Capability for Sitka Black-Tailed Deer, Years 1-100

		Winter Range Habitat Acres[2]				
HSI[1] Category	VCU	No-Action	Alt. 2	Alt. 3	Alt. 4	Alt. 5
"Good" (0.7<HSI≤1)	429	0	0	0	0	0
	436	0	0	0	0	0
	438	0	0	0	0	0
	Total	**0**	**0**	**0**	**0**	**0**
"Average" (0.3<HSI≤0.7)	429	7,861	7,451	7,703	7,456	7,466
	436	801	725	797	795	789
	438	285	268	268	268	268
	Total	**8,947**	**8,443**	**8,768**	**8,520**	**8,522**
"Below-Average" (0<HSI≤0.3)	429	41,445	41,616	41,470	41,611	41,629
	436	17,360	17,336	17,334	17,322	17,297
	438	19,907	19,865	19,871	19,871	19,886
	Total	**78,711**	**78,816**	**78,675**	**78,803**	**78,811**
"Unsuitable" (HSI=0)	429	4,258	4,498	4,391	4,497	4,469
	436	3,052	3,152	3,082	3,095	3,127
	438	13,203	13,262	13,256	13,256	13,241
	Total	**20,513**	**20,912**	**20,729**	**20,848**	**20,838**

1 Habitat Suitability Index (HSI) calculated by the habitat capability model for Sitka black-tailed deer.
2 No change in acreages under the four HSI categories occurs between 1-25 and 25-100 years post-harvest.

Roadway construction is considered an elimination of habitat and therefore shifts roadway acreage to an "unsuitable" HSI category. Roadway construction has the added impact of potentially facilitating predation of deer by wolves. Where possible, interception of roads, harvest units, and wildlife corridors were avoided during the interdisciplinary planning process; however, not all could be avoided.

At least a portion of many units (Harvest Units #5, 7, 10, 14, 23, 24, 25, 28, 35, 37, 40, 42, 43, 48, 51, 52, 54, 55, and 81) are characterized as "average" but represent some of the best deer winter range habitat in the Shamrock area. The Narrows Conservation Coalition (Knight, 1992) has expressed an opinion that adequate habitat must be available to allow the recovery of deer populations to historical levels. Similar concerns were stated by ADF&G (Reed, 1992). Because winter habitat is the primary limiting factor for deer survival in Southeast Alaska, harvest in these locally-favorable (although classified as "average") habitats could affect the recovery of deer populations on Kupreanof Island. Of the 19 harvest units characterized as "average" deer winter range, 8 are common to all alternatives. The remaining 11 units occur in Alternative 2 but not in Alternative 3. Seven of the 11 units occur in Alternatives 4 and 5. Consequently, Alternative 3 is the most favorable action alternative towards preserving deer winter range, Alternative 2 is least favorable, and Alternatives 4 and 5 are intermediate. However, under all action alternatives, harvest of the locally-important deer winter range is less than 9.3 percent of the habitat for a specific VCU, and is only 5.5 percent of the total high-value winter range in the Shamrock area.

Shifts in habitat suitability resulting from harvest alternatives would slightly decrease the capacity of the analysis area to support populations of Sitka black-tailed deer. Carrying capacity is predicted to decline by 1.6 to 3.8 percent overall for the life of the project (Table 4-11A). These estimates assume that 100 deer per square mile could occur in areas where HSI scores equal 1.0.

Population objectives for National Forest Lands have been established and updated in 1993 by ADF&G as part of a comprehensive management program for Sitka black-tailed deer in Southeast Alaska. Proposed population objectives are 2,192 deer for WAA 5130 and 1,300 deer for WAA 5133 (total of 3,492 deer). Habitat conditions after harvest for all alternatives provide sufficient carrying capacity to meet these population objectives (Table 4-11B). See Figure 4-2 for location of WAAs 5130 and 5133 on Kupreanof Island.

Marten

Almost 12 percent of the Shamrock area is "good" marten habitat, 28 percent is "average" habitat, 44 percent is "below-average," and 17 percent is "unsuitable" (Table 4-12). Timber harvest alternatives would alter 343 to 959 acres of the "good" habitat in the entire Shamrock area; the proportional loss could be greater than 11 percent of the "good" habitat in VCU 436 (Table 4-12). Harvest alternatives would also alter 674 to 1,575 acres of the "average" habitat. As much as 399 acres of the Shamrock area would be occupied by roadways and become "unsuitable." Because of the dependency of marten upon old-growth habitat, all proposed harvest activities shift the suitability of the affected Shamrock area habitat to a "below-average" classification for harvested acreage and to an "unsuitable" classification for roadways. Similar to deer, the change from clearcut to second-growth does not result in a change in acreage classified into the four HSI categories. Specific suitability of the acreage, however, does change resulting in different carrying capacities for marten between clear-cut and second growth. Implementation of Alternative 2 would have the greatest affect on existing

marten habitat followed by Alternatives 4 and 5 (similar effects), Alternative 3, and Alternative 1.

For the Shamrock area, carrying capacity for marten is predicted to decline by as much as 4.0 percent overall (Table 4-13). Within specific VCUs, carrying capacity is predicted to decline by up to 6.6 percent (VCU 436). These estimates assume a population of four marten per square mile where optimally-suited habitat is present.

Table 4-11A

Predicted Post-Harvest Carrying Capacities for Sitka Black-Tailed Deer in Each VCU [1]

VCU	Number of Deer								
	No-Action	Alt. 2		Alt. 3		Alt. 4		Alt. 5	
Year	1-100	1-25	25-100	1-25	25-100	1-25	25-100	1-25	25-100
429	1,533	1,501	1,485	1,518	1,510	1,501	1,486	1,503	1,488
436	318	295	293	314	314	312	312	306	305
438	254	246	245	246	246	246	246	247	247
Total	**2,104**	**2,041**	**2,024**	**2,076**	**2,070**	**2,059**	**2,043**	**2,056**	**2,041**

[1] Number of deer were calculated from modeled post-harvest habitat acreage and are not observed population estimates. Numbers have been rounded-off.

Table 4-11B

Predicted Post-Harvest Carrying Capacities for Sitka Black-Tailed Deer in Each WAA[1]

WAA	Number of Deer									
	No-Action	Alt. 2		Alt. 3		Alt. 4		Alt. 5		ADF&G
Year	1991	1-25	25-100	1-25	25-100	1-25	25-100	1-25	25-100	Objectives
5130	2,828	2,796	2,780	2,813	2,805	2,796	2,781	2,798	2,783	2,192
5133	1,664	1,633	1,630	1,652	1,652	1,650	1,648	1,645	1,644	1,300

[1] Number of deer were calculated from post-harvest habitat acreage and are not observed population estimates. Number of deer predicted inside study area (Table 4-11A) were combined with number of deer predicted outside study area in each WAA, as determined from TLMP SDEIS database.

Figure 4-2
Location of Wildlife Analysis Areas (WAA) on Kupreanof Island

Source: ADF&G (1991b)

Table 4-12

Modeled Post-Harvest Habitat Capability for Marten, Post-Harvest Years 1-100

		Habitat Acres[2]				
HSI[1] Category	VCU	No-Action	Alt. 2	Alt. 3	Alt. 4	Alt. 5
"Good"	429	6,258	5,910	6,147	5,915	5,924
(0.7<HSI≤1)	436	4,056	3,594	3,972	3,928	3,807
	438	2,442	2,293	2,293	2,293	2,318
	Total	**12,756**	**11,796**	**12,413**	**12,136**	**12,049**
"Average"	429	15,091	14,404	14,651	14,412	14,477
(0.3<HSI≤0.7)	436	7,518	6,876	7,448	7,365	7,209
	438	7,333	7,085	7,168	7,168	7,172
	Total	**29,941**	**28,366**	**29,267**	**28,946**	**28,859**
"Below-Average"	429	29,074	29,871	29,494	29,859	29,812
(0<HSI≤0.3)	436	7,159	8,163	7,283	7,396	7,641
	438	11,030	11,366	11,290	11,290	11,276
	Total	**47,264**	**49,400**	**48,067**	**48,545**	**48,729**
"Unsuitable"	429	3,141	3,379	3,272	3,378	3,350
(HSI=0)	436	2,480	2,580	2,510	2,523	2,555
	438	12,590	12,650	12,643	12,643	12,628
	Total	**18,210**	**18,608**	**18,425**	**18,545**	**18,534**

[1] Habitat Suitability Index (HSI) calculated by the habitat capability model for marten.

[2] No change in acreages under the four HSI categories occurs between 1-25 and 25-100 years past harvest.

Table 4-13
Predicted Post-Harvest Carrying Capacities for Marten

VCU	Number of Marten[1]								
	No-Action	Alt. 2		Alt. 3		Alt. 4		Alt. 5	
Year	1-100	1-25	25-100	1-25	25-100	1-25	25-100	1-25	25-100
429	133	130	129	131	131	130	129	130	129
436	61	58	57	61	61	60	60	59	59
438	57	55	55	55	55	55	55	56	55
Total	**251**	**242**	**241**	**248**	**247**	**245**	**245**	**245**	**244**

[1] Number of marten were calculated from modeled post-harvest habitat acreage and are not observed population estimates. Numbers have been rounded off.

Black Bear

Black bear habitat in the Shamrock area is predominantly "good" and "average," which combined include 94,784 acres (88 percent) of the Shamrock area (Table 4-14A and B). Nearly all harvests and road construction occur within these two habitat categories. Overall, timber harvest activities would affect up to 5.8 percent of the "good" habitat in the entire analysis area, while alteration of "good" habitat within VCU 436 exceeds nine percent of the available habitat (Table 4-14A and B). The suitability of clearcuts to black bear falls into the "average" category, while second-growth habitat is "unsuitable" for black bear. Thus, implementation of harvest alternatives produces a complex shifting of habitat suitability over the rotation life of the project. During the first twenty-five years after harvest, there is a net increase in the amount of "average" and "unsuitable" habitat, which occurs as old-growth habitat is converted to clearcut or roaded habitat. As the clearcuts reach a second-growth successional age, these habitats become "unsuitable" for bear because the shrub understory is lost with the closing-in of the tree canopy. Consequently, during years 25 through 100 of the harvest rotation, there is a loss of "average" habitat and a concurrent increase in the amount of "unsuitable" habitat. Alternative 3 would be most favorable to preserving bear habitat, while Alternative 2 is the least favorable; Alternatives 4 and 5 are intermediate to these other two alternatives with respect to the habitat alteration.

For the Shamrock area, carrying capacity for black bear is predicted to decline by as much as 0.6 percent during the first 25 years after harvest, and by as much as 3.5 percent during the second-growth phase of the rotation life, depending upon the action alternative (Table 4-15). These estimates assume that 1.9 bear per square mile could occur where optimally-suited habitat is present.

River Otter and Bald Eagle

The Shamrock area contains only 8,686 acres (8.0 percent) of potential river otter habitat; the remaining 99,500 acres are "unsuitable" for river otter (HSI=0). Potential bald eagle habitat constitutes 4,982 acres (4.6 percent) of the Shamrock area, with

greater than 103,000 acres being "unsuitable" (HSI=0) for bald eagle. Timber harvest activities would only occur in "unsuitable" habitats (for these two species) because stream and lake buffer zones exclude harvest activities from watercourses and waterbodies that constitute potential habitats. Roadway crossings, however, do encroach upon potential riparian habitats. Under the action alternatives, there would be from 16 to 26 roadway crossings of Class I or II streams. Potential impacts to riparian resources caused by roadway crossings include loss of vegetation, alterations in stream channel shape or structure, or alterations in streamflow depth or velocity. These impacts could adversely affect fish populations in streams, which are important food resources for these MIS. However, planned implementation of a variety of BMPs for construction and operation of streamside crossings should prevent significant adverse impacts to riparian habitats and fish populations, and therefore prevent significant losses of river otter and bald eagle habitats.

Table 4-14A
Modeled Habitat Capability for Black Bear, Post-Harvest Years 1 to 25

		Habitat Acres				
HSI[1] Category	VCU	No-Action	Alt. 2	Alt. 3	Alt. 4	Alt. 5
"Good" (0.7≤HSI≤1)	429	21,580	20,544	21,028	20,556	20,631
	436	11,812	10,708	11,658	11,532	11,255
	438	10,058	9,662	9,745	9,745	9,774
	Total	**43,450**	**40,915**	**42,431**	**41,833**	**41,660**
"Average" (0.3<HSI<0.7)	429	30,261	31,058	30,682	31,047	31,000
	436	8,254	9,258	8,378	8,491	8,736
	438	12,818	13,154	13,078	13,078	13,064
	Total	**51,334**	**53,471**	**52,138**	**52,616**	**52,800**
"Below-Average" (0<HSI≤0.3)	429	1,064	1,063	1,063	1,063	1,063
	436	1,016	1,016	1,016	1,016	1,016
	438	4,372	4,372	4,372	4,372	4,372
	Total	**6,451**	**6,450**	**6,450**	**6,450**	**6,450**
"Unsuitable" (HSI=0)	429	659	898	791	898	870
	436	131	231	161	175	207
	438	6,146	6,206	6,200	6,200	6,185
	Total	**6,936**	**7,335**	**7,152**	**7,272**	**7,261**

[1] Habitat Suitability Index (HSI) calculated by the habitat capability model for black bear.

Table 4-14B
Modeled Habitat Capability for Black Bear, Post-Harvest Years 25 to 100

		Habitat Acres				
HSI[1] Category	VCU	No-Action	Alt. 2	Alt. 3	Alt. 4	Alt. 5
"Good"	429	21,580	20,544	21,028	20,556	20,631
(0.7≤HSI≤1)	436	11,812	10,708	11,658	11,532	11,255
	438	10,058	9,662	9,745	9,745	9,774
	Total	**43,450**	**40,915**	**42,431**	**41,833**	**41,660**
"Average"	429	30,261	29,007	29,078	29,009	29,036
(0.3<HSI<0.7)	436	8,254	8,202	8,243	8,242	8,230
	438	12,818	12,778	12,791	12,791	12,791
	Total	**51,334**	**50,887**	**51,012**	**50,942**	**50,957**
"Below-Average"	429	1,064	1,063	1,063	1,063	1,063
(0<HSI≤0.3)	436	1,016	1,016	1,016	1,016	1,016
	438	4,372	4,372	4,372	4,372	4,372
	Total	**6,451**	**6,450**	**6,450**	**6,450**	**6,450**
"Unsuitable"	429	659	2,050	1,495	2,036	1,934
(HSI=0)	436	131	1,286	295	423	712
	438	6,146	6,583	6,487	6,487	6,458
	Total	**6,936**	**9,919**	**8,278**	**8,946**	**9,104**

[1] Habitat Suitability Index (HSI) calculated by the habitat capability model for black bear.

Wildlife Corridors

An important criterion in planning the Shamrock timber sale was to avoid placing units in areas that could prevent wildlife movement between forests and major stream corridors. As part of the interdisciplinary process, Harvest Units 6, 10, 23, 35, 50, and 82 were later added to increase economic efficiency and minimize road mileage. Although interdisciplinary team planning processes attempted to minimize impacts to these corridors, some of these latter units may affect wildlife movements. All of these units are in Alternatives 2 and 5, five are in Alternative 4, and none are in Alternative 3. Consequently, Alternative 3 is more favorable towards allowing wildlife movement and Alternatives 2 and 5 are less favorable. Alternative 4 is intermediate.

Table 4-15
Predicted Post-Harvest Carrying Capacities for Black Bear

VCU	Number of Bear								
	No-Action	Alt. 2		Alt. 3		Alt. 4		Alt. 5	
Year	1-100	1-25	25-100	1-25	25-100	1-25	25-100	1-25	25-100
429	91	90	88	90	89	90	88	90	88
436	37	37	35	37	37	37	37	37	36
438	42	42	41	42	41	42	41	42	41
Total	**170**	**169**	**164**	**170**	**168**	169	166	169	166

[1] Number of bear were calculated from modeled post-harvest habitat acreage and are not observed population estimates. Numbers have been rounded-off.

Threatened, Endangered, and Candidate Species

Threatened Species

Steller sea lions occur in waterways surrounding Kupreanof Island, but no critical habitat has been designated within the analysis area. Harvesting timber in the interior of Kupreanof Island is not expected to directly affect Steller sea lions or their habitat (USDA Forest Service, 1993). However, because action alternatives potentially affect Shamrock area freshwater resources, changes to salmon populations might possibly affect habitat utilization by the sea lion in the Shamrock area estuary. Potential changes to salmon populations are addressed in the fish section of this chapter. As proposed, harvested timber would be processed through the existing Hamilton LTF and then transported through the waterways surrounding Kupreanof Island. No new LTFs are associated with the Shamrock harvest.

Spectacled eiders are very unlikely to occur around Kupreanof Island; and if they were to occur in the vicinity of the project, they would be found in estuarine tidal flats along Duncan Canal. Consequently, no impacts to spectacled eider are expected from the proposed Shamrock Timber Sale.

Endangered Species

Several endangered whale species potentially occur in waterways surrounding Kupreanof Island, and the humpback whale has been observed in Duncan Canal (National Marine Mammal Laboratory, 1992). No critical habitat for any of these species has been designated within the Shamrock area. The proposed Shamrock action alternatives are not expected to affect humpback whales or their habitat (USDA Forest Service, 1993).

The American peregrine falcon may occur in the Shamrock area, but no critical habitat has been designated for this species. Because this peregrine falcon subspecies would most likely be a transient, appearing only during the seasonal migration periods,

future activities associated with the proposed Shamrock area timber harvest should not adversely affect this falcon subspecies (Holmberg, 1992).

Northern Goshawk Nests

The northern goshawk is currently a federal Category 2 candidate species for listing as threatened or endangered and is an Alaska Region Sensitive Species. Northern goshawk nests have been located in the Shamrock area near Big John Lake and to the south of the Shamrock area. A biological evaluation has been conducted (see planning record) for the goshawk. A finding was determined that this sale may affect individual goshawks, but it is not likely to cause a trend to federal listing or a loss of viability on the Tongass National Forest.

Big John Creek Nest. As described in the Shamrock DEIS, a northern goshawk nest area was found in 1992 in the Big John Creek watershed. Application of the Interim Guidelines for Goshawk Habitat Management had been proposed in some of the Action Alternatives included in the North Irish Reoffer to account for the known goshawk nesting in the region. The Interim Guidelines call for (1) delineation of a 30 acre nest area [NA] in which no vegetative management is allowed, (2) delineation of a 600 acre post-fledging area [PFA] of which 570 acres should be a nearly-contiguous forested habitat that mimics the general habitat composition of the NA, and (3) planning considerations that include a 6,000 acre foraging area [FA], with at least 20 percent of the FA being Volume Class 4 or greater. As detailed within the North Irish Reoffer Environmental Assessment, the Interim Guidelines were followed for the delineation of both an NA and PFA around the known nest location (see Appendix C). For planning purposes, a 6,000 acre circular foraging areas was also established around the nest location. The size of the foraging area recommended by the Interim Guidelines was based upon the average size of foraging areas for goshawks in the United States; ongoing research is being conducted to evaluate the relevance and applicability of this guideline to goshawk foraging areas in Southeast Alaska.

Retention Area 429A surrounds the known nesting area, and contains 974 acres of old-growth forest within an overall area of 2,288 acres. Thus, this retention area meets the requirements of a PFA for goshawks that may nest in the region, while concurrently meeting the requirements for a small HCA, as described by Suring et al. (1992). Because retention areas are designated to remain as old-growth through the life of the project, this area helps ensure that old-growth habitat will remain available for goshawk and other old-growth-dependent species.

Additional information has recently been collected concerning home ranges of goshawks within Southeast Alaska. The home range includes the area over which a goshawk ranges to conduct its various life activities (foraging, nesting, caring for young, seasonal movements, etc.). Radiotelemetric data from goshawk pairs in Southeast Alaska indicate that total home ranges may encompass up to 200,000 acres of terrestrial habitat (ADF&G, 1993), although the median home range from the data collected through May 1994 is approximately 15,000 acres (ADF&G, 1994).

Specific radiotelemetric data on the female-male goshawk pair nesting in the Big John Creek watershed indicated use areas (area which includes all telemetry locations except for outliers and excludes saltwater) for the breeding season as 758 and 16,173 acres for the female and male, respectively (DeGayner, personal communication). The female left the area just before the young fledged and did not winter on Kupreanof Island. The male winter use area consisted of 58,778 acres primarily concentrated within the Big John Creek watershed. Shamrock Harvest Units 5, 6, 7, 8,

10, 11, 13, 14, 45, 50, 77, and N19 occur within the male's winter use area, totaling 773 acres for Alternatives 2, 3, and 4; Alternative 5 includes all of the listed units except for 11 and 77 for a total of 710 acres. The removal of 773 or 710 acres would represent less than a 4 percent reduction of Volume Class 4 plus timber within winter use area. Units or portions of Units 6, 7, N19, and 14 totaling 167 acres are within the male breeding area for all alternatives. The removal of 167 acres represents less than a 3 percent reduction of the Volume Class 4 plus timber within the breeding male use area. For all alternatives, harvest units do not occur within the female breeding use area.

The Big John Creek female nested with another male in 1994 at the Bay of Pillars on Kuiu Island. The transmitter of the Big John Creek male failed in March 1994 and its status is unknown. The Big John nest site was not found to be active in 1994 or 1995.

Totem Creek Nests. Two goshawk nest areas have been located in the Totem Creek drainage to the south of the Shamrock area. A nest area in the upper Totem Creek drainage was discovered and appeared to be active in 1993 but was found not to be active in 1994. The 6000 acre circular FA around this nest area falls partially within the Shamrock area, but no Shamrock units or roads are proposed within this FA. A second nest area, referred to as the Totem Town goshawk nest, was discovered and found to be active in 1994; it is located approximately 1.75 miles SE from the upper Totem Creek goshawk nest. The 6000 acre circular FA around the Totem Town goshawk nest includes Shamrock Unit 52. After harvest of this unit (41 acres), over 30 percent of the FA would remain as Volume Class 4 or greater. Since no radio-telemetry transmitters have been attached to goshawks from either of the nests in the Totem Creek drainage, it is not known if the two nests have been occupied by the same goshawks, nor are there any data on home ranges. Both Totem nests were visited in 1995 and neither was found active.

Alexander Archipelago Wolf

To evaluate the effects of harvest on Alexander Archipelago wolf (Federal C2, candidate species) in the study area, habitat capability for the wolf was estimated for each alternative using the HCM developed by Suring and DeGayner (1988). This model is based on the abundance of primary prey, which on Kupreanof Island is mostly deer and secondarily moose. Values for deer abundance used in the model were those of deer carrying capacity estimated for each alternative (Table 4-11a). Since there is no moose habitat capability model, a constant value of 1 moose/mi^2 was used for all alternatives.

The results of the analysis indicated that for the no action alternative (i.e., existing conditions) wolf carrying capacity averaged 0.043 wolf/mi^2 for the entire Shamrock area, which is equivalent to a carrying capacity of 7.32 wolf for the 169 mi^2 comprising the Shamrock area. (Note that these numbers do not represent actual wolf population numbers, but rather are model output of carrying capacity and are intended for comparison among areas and alternatives.) Carrying capacity in individual VCUs ranged from 0.21 wolf/mi^2 for VCU 438 to 0.60 wolf/mi^2 for VCU 429. Under the action alternatives, wolf carrying capacity would decrease by 0. 08 (Alternative 3, 1-25 years post harvest) to 0.24 (Alternative 2, 25-100 years post harvest) animals over the entire Shamrock area. Under the preferred alternative, there would be a decrease in carrying capacity of 0.14 (1-25 years post-harvest) and 0.18 (25-100 years post harvest). These decreases in wolf carrying capacity are not expected to be significant.

Also affecting wolf populations would be increased access and human activity, which are likely to result in increased hunting and trapping pressures on wolf. Although

effects of access are not easily quantified, Kirchhoff (1992) recommended that road densities, including accessible shoreline, be kept below 1.0 road miles per square mile in three adjacent WAAs, in order to maintain viable and well-distributed populations of wolf in Southeast Alaska. For WAAs 5130, 5131, and 5133, which include the Shamrock area and lands to the north, road plus accessible shoreline densities would be 0.42 for Alternative 2, 0.38 for Alternative 3, and 0.40 for Alternatives 4 and 5 (assuming that 90 percent of the shoreline along Duncan Canal and Rocky Pass adjacent to these WAAs would be accessible by skiff). Since these densities are well below the recommended limit of 1.0 mile per square mile, it would not appear that increased access should threaten wolf viability in the Shamrock and surrounding area.

Another recommendation of the viability committee (Suring et al., 1992) is to maintain habitat capability sufficient to provide for equilibrium populations of predators and prey. Where deer are the primary prey, a minimum density of 5 deer per square mile is recommended. For the Shamrock area, estimated carrying capacities are equivalent to deer densities well above this minimum density for VCUs 429 and 436 (18.3 and 9.6 deer, respectively) under the no action alternative, and effects of the proposed harvest result in a decrease of less than 1 deer per square mile for all alternatives. In VCU 438, however, under existing conditions estimated carrying capacity is equivalent to a density of 4.9 deer per square mile, less than the minimum density recommended by Kirchhoff (1992). Densities during the 25-100 year second growth period following the proposed harvest would range from 4.70 (Alternative 2) to 4.73 (Alternative 5). Although these decreases in deer density are minor, they would exacerbate existing limitations of wolf prey in VCU 438.

Other Candidate Species

The preference for maritime habitats by the spectacled and Steller's eiders suggest that these species are not likely to be affected directly by timber harvest activities in the interior of Kupreanof Island. Harlequin ducks were observed in maritime habitats around Kupreanof Island, and potentially utilize other habitats occurring in the Shamrock area. However, because Shamrock area harvest-related activities generally do not occur within aquatic and aquatic fringe zones, there are no likely adverse effects for this waterfowl species. Although the spotted frog is primarily a freshwater aquatic species, this frog may range into upland habitats. Because little is known of the population status of this species in Southeast Alaska, impacts to the spotted frog resulting from Shamrock area harvest activities are unknown.

Because marbled murrelets are thought to nest predominantly in old-growth forests, any harvest of old-growth forest potentially removes marbled murrelet nesting habitat for the length of time it takes the harvested area to return to old-growth conditions. Marbled murrelets were observed throughout the Shamrock area, but nest locations are unknown. If all old-growth vegetation is assumed to be potential nesting habitat for marbled murrelet, the proposed harvest would decreased potential nesting habitat by 5.5 percent. Population size of marbled murrelets in the Shamrock area is unknown, therefore the number of birds potentially affected by the proposed action is also unknown.

Though information on olive-sided flycatcher is limited, we believe that the population of this species will remain stable or possibly increase within the study area. Most forested edge habitat associated with beaver ponds is protected by TTRA fish stream buffers, and harvesting of old-growth stands will produce additional forested edge habitat.

Since the Kittlitz murrelet is not known to occur within the study area and seems to be associated with the coastal mountainous areas of the mainland, the sale is expected to have no impact to Kittlitz murrelets.

Sensitive Species

Nesting osprey are present in the Duncan Canal estuarine fringe. Osprey share similar habitat requirements with bald eagles, which were not effected by any action alternatives. Therefore no adverse impacts to the osprey are expected as a result of the Shamrock timber harvest. Identification of nesting osprey within the Shamrock area is notable because this species are infrequently observed in Southeast Alaska, and even more infrequently observed in active breeding. A biological evaluation was conducted (see the planning record) for the Queen Charlotte Goshawk; Peale's Peregrine Falcon, Osprey, and Trumpeter Swan. A finding of no effect was determined for this sale for the Trumpeter Swan, Osprey, and Peale's Peregrine Falcon. A finding was determined that this sale may affect individual goshawks, but it is not likely to lead to federal listing or loss of viability on the Tongass National Forest.

Additional Special-Status Species

The USFWS expressed concern for the Vancouver Canada goose, a species outside of threatened, endangered, candidate, sensitive, or project MIS status. The Vancouver Canada Goose is a commonly-observed breeding species of waterfowl in Southeast Alaska (Taylor, 1979). A Canada goose nest was observed at two unnamed lakes near Harvest Units 1 and 2 (locally called Kluane Lakes) in the Shamrock area, and several were heard flying overhead on other occasions. Where breeding activity of Vancouver Canada geese is noted, proposed Tongass Forest-wide standards and guidelines for waterfowl habitat (USDA Forest Service, 1991) prohibit activities within 410 feet of geese nest locations during nesting, brood rearing, molting, and wintering periods. A road is proposed near the muskeg habitat where the goose was observed on the nest (near Harvest Unit 1), but the right-of-way does not enter the buffer zone. In addition, the buffer zones required around lakes and streams generally preclude timber harvest activities near habitat that might be utilized by waterfowl. Vancouver Canada geese and other waterfowl are not expected to be adversely affected by the Shamrock timber sale(s).

Cumulative Effects

Cumulative effects result from summation of past (since 1954), present, proposed, and foreseeable activities in the Shamrock area. Past activities in the Shamrock area are limited to a small harvest in the Big John Creek drainage as part of the North Irish Timber Sale. Presently, the majority of the Shamrock area is roadless old-growth forest and any human activities are limited to occasional recreational uses and limited subsistence, hunting, or trapping uses. The proposed timber harvest alternatives associated with the Shamrock EIS present the most significant changes to the Shamrock area.

Designation of Retention Areas

The Forest Plan prescribes the retention of some old-growth habitat. The Shamrock area is all LUD-IV and managed for intensive resource use and development. Retention goal acreage is developed from a proportional combination of various wildlife habitats found in the analysis area. Current practice of the Forest Service is to designate specific "Areas to be Managed as Old-Growth for the Life of the Project" for compliance with retention goals. Habitat Capability Modeling is one means to evaluate high-value wildlife habitat for individual MIS and to provide data relevant to the selection of retention areas.

Considerable high-value MIS habitat is available in the Shamrock area (see Tables 4-10, 4-12, and 4-14), particularly in the western portion (which is not slated for logging or road development under the Shamrock Timber Sale[s]). Retention areas were delineated to include substantial areas of high-value habitat for at least one, and preferably several, MIS. Acreages of retention goals, designated retention areas, and high-value MIS habitat within the designated retention areas are shown in Table 4-16. There is also considerable area within Tongass Timber Reform Act (TTRA) stream buffers, beach and estuary buffers, and potential Wild and Scenic River corridors that can be considered retention, since no harvest is permitted in these areas. Acreages of these areas are also shown in Table 4-16. Figure 4-3 shows the location of retention areas designated for the Shamrock Timber Sale(s). These retention areas are designated for all four action alternatives and are distributed among the three VCUs present in the Shamrock area to comply with Forest Plan retention requirements.

An alternative approach to the intent of retention acreage has been proposed by the Viable Populations Committee (Suring et al., 1992). In this approach, a network of small, medium, and large Habitat Conservation Areas (HCAs) would maintain viable populations of old-growth dependent species (e.g., northern goshawk, marten, and flying squirrel). In selecting the location of HCAs, particular attention is given to including large blocks of old-growth forest and areas of high Habitat Suitability Index (HSI) determined in the HCM analyses for old-growth dependent MIS.

Table 4-16

Apportionment of Old-Growth Habitat and High-Value MIS Habitat to Retention Areas in the Shamrock Area

		Retention Area[1]						
						High-Value MIS Habitat[2]		
VCU	Retention Goal CFL[3] (Acres)	Retention Area Number	Retention Area (Acres)	Suitable CFL (Acres)	Old-Growth (Acres)	Deer (Acres)	Bear (Acres)	Marten (Acres)
429	630	429A	2,288	364	974	101	971	138
		429B	2,895	896	1,526	1,142	1,526	584
		429C	2,782	1,216	1,528	787	1,526	553
		Total	7,382	2,476	3,634	2,030	3,792	1,275
436	486	436A	2,561	914	1,428	39	1,478	470
		436B	2,531	1,281	1,757	106	1,732	471
		Total	5,092	2,195	2,999	145	3,216	941
438	373	438A	2,784	358	1,416	35	1,413	535
		438B	2,259	561	1,196	84	1,190	403
		Total	5,043	919	2,102	118	2,214	935

[1] Additional retained areas in each VCU include TTRA stream buffers, potential wild and scenic river corridors, and beach and estuary buffers. These areas total 8,405 acres (VCU 429), 4,516 acres (VCU 436), and 2,198 acres (VCU 438).

[2] Habitat defined as "good" (marten and bear) or "average" (deer).

[3] Total CFL in each VCU is 12,665 acres (VCU 429), 7,978 acres (VCU 436), and 4,943 acres (VCU 438).

Figure 4-3. Areas to be Managed as Old-Growth for the Life of the Project

Portions of the Shamrock area designated for retention under existing Forest Plan requirements could also serve as small HCAs. These areas (shown in Figure 4-3) consist of sufficient total area (>1,600 acres) and areas of old-growth (>800 acres) to meet the criteria for small HCAs, as defined by Suring et al. (1992). Corridors of forest land would remain between all neighboring retention areas except between areas 429c and 436a, where a corridor of continuous forest is not present under existing conditions. In addition, forested corridors exist between the large block of unharvested forested land along Rocky Pass to the west of the Shamrock area and retention areas 429a, 429b, and 429c and between the large block of unforested land to the southeast of the Shamrock area and retention area 436b.

The retention area boundaries were located, where possible, along watershed boundaries or along elevational contours that separate high-value MIS habitat from lower value habitat. Some boundaries, however, are subjective crossings of drainages and other territories. Collectively, these various retention areas provide a mosaic of conserved habitats within the Shamrock area that would allow for subsequent dispersion of wildlife and protection of habitat throughout the landscape.

Mitigative Measures and Monitoring

Proposed mitigative measures for wildlife include retention of slash (residual biological material), snags (standing dead trees), and green trees. These mitigative measures, as specified in the unit descriptions (Appendix A) are proposed to provide a progressive, forward-thinking consideration of the future use of the affected area by wildlife species. Retained snags supply an important landscape feature that help maintain some structural diversity in an area planned for even-aged forestry management practices. Monitoring plans for wildlife habitat and populations are included to document changes in wildlife species richness and abundance, to evaluate habitat utilization by MIS, and to verify the status of northern goshawk within units prior to harvest.

Slash Retention

Slash retention is within standard practice for clearcut harvest methods in Southeast Alaska. The explicit requirement for slash retention in logging prescriptions for every proposed harvest unit is stated to allow the recognition that slash provides cover habitat for wildlife species such as amphibians, songbirds that utilize the understory, and small mammals. An added benefit lies in the interception of rainfall and disruption of surface run-off, which can reduce soil erosion within harvested sites.

Snag Retention

Snag management is receiving increasing attention as a means to enhance wildlife presence in sites of timber harvest (e.g., Cline et al., 1980; McComb et al., 1986; Neitro et al., 1985; Schreiber and deCalesta, 1992; Tobalske et al., 1991). Snags provide potential perching, feeding, and nesting sites for cavity-nesting bird and mammalian species, and they provide perching sites for raptors and other birds. Snag characteristics in old-growth forests range through various stages of decomposition with respect to limb and branch structure, snag-top characteristics, snag height, bark cover, sapwood and heartwood presence and condition, and age (Cline et al., 1980; Neitro et al., 1985). Cline et al. (1980) define "hard snags" as being of Stage 1 or 2 deterioration class, and "soft snags" as being of Stage 3 or greater. Characteristics of Stage 1 snags include: limbs and branches all present; pointed top; and 100 percent bark cover, with intact, sound sapwood and heartwood. These conditions deteriorate as snags progress through the other stages, such that a Stage 5 snag has no limbs or

branches, a large-diameter broken top, little bark remaining, sapwood missing, and heartwood considerably decayed. "Green" snags are living trees that may provide future snag habitats.

Harvest Units 7, 20/20-M, 24-25, 31-33, 40, 43, 47, 54, and 81 include areas with surface- or helicopter-logging methods that permit snag retention within constraints of on-ground safety. Mitigative measures of snag retention at a rate of 1.5 snags per acre (with a distribution ratio of two hard snags per one soft snag) are prescribed for these units, based on consideration of relative effort, cost, and safety factors.

Selection of snags within harvest units should attempt to mimic the existing species composition and include all deterioration stages. Species composition averages 78.5 percent western hemlock in the sixteen harvest units where snag retention has been prescribed. Thus, snag species selection should concentrate on western hemlock, with minor components of other species. Because larger snags are preferable to smaller snags for most snag-dependent wildlife species (Neitro et al., 1985), and because the existing conditions within proposed harvest units are of sizable, uneven-aged trees, retained snags should also be dominated by larger sized snags. Based on snag diameter preferences of the red-breasted sapsucker in northwestern forests (Neitro et al., 1985) and because this is a bird commonly encountered in the analysis area, a minimum snag diameter of 15 inches is prescribed for hard snag retention. In addition, trees in proposed harvest units typically exceed 100 feet in height, so hard snags should exceed a minimum height of 50 feet. Soft snag selection will be at the cutter's discretion, but by definition, should include Stage 3 (or greater) decomposition class snags. Specific selection should operate under the general guidance that larger, taller snags are preferable.

Green Tree Retention

Harvest Units 7, 15, 23, 28, 29, 36, 55, 61, and 81 would include areas with green tree retention. This silvicultural technique has been proposed to reduce visual impacts (e.g., Brunson and Shelby, 1992), but it also promotes stand structural diversity and is a potential source material for future snags. Green tree retention has been previously attempted on northern Mitkof Island to enhance blue grouse breeding habitat in clearcuts (Doerr, 1992). That area was logged in 1984, and spring bird surveys were conducted in 1992 to determine use of residual trees by breeding blue grouse and other birds. Results indicated that green tree retention is technically feasible, although up to a 25 percent tree loss may occur from windthrow and logging operations. The residual trees were utilized by red-breasted sapsuckers, hairy woodpeckers, and other species of songbirds. Doerr found that the clearcut with the most bird use had the highest density of clumped trees. He recommended that future green tree retention include 6-24 inch dbh live trees (preferably hemlock) selected in clumps of 17 to 40 trees, or else a combination of snags and live trees. These recommendations should be followed in those Shamrock areas planned for green tree retention. Tree size and height should be similar to the hard snag parameters described above.

Roads and Logging Facilities

Recovery of roaded forest areas, through ecological succession, would take considerable time (>200 years) for a return to old-growth characteristics. Measures to hasten the recovery of temporarily roaded areas include construction of water-bars along abandoned roadways to minimize erosional losses, and fertilization and revegetation of roadway corridors, as detailed in Latimer (1993).

It is not possible to mitigate habitat loss caused by log sorting, scaling, and storage, but the overall extent of habitat loss is very slight (less than approximately 15 acres maximum). Operation of these facilities is not likely to produce irreparable adverse effects for wildlife or their habitats.

Monitoring Plans

Monitoring of wildlife populations prior to harvest activities, and ongoing after timber harvest, through the lifetime of the rotation has been requested to document the long-term changes in wildlife populations and habitat utilization resulting from timber resource consumption (Reed, 1992; Knight, 1992). Monitoring on Kupreanof Island, although not necessarily the Shamrock area, should be designed to identify cumulative effects, determine population sizes of important species on the island, and document the island's sensitivity to human-related activities. Pre-harvest baseline estimates of population abundance would allow empirical evaluation of the effects of timber harvest, and could be used to test assumptions currently contained within habitat capability assessments. Monitoring should be conducted both in harvested and undisturbed areas. Monitoring should target MIS species, because these species should forecast changes in other wildlife; amphibians and small mammals because so little is known about their presence on Kupreanof Island; songbirds because they are easy to identify and estimate relative abundance; deer because they are an important game and subsistence species; and threatened, endangered, and candidate species. The effort need not be extensive if qualified and experienced wildlife biologists conduct the field studies.

Monitoring of the goshawk nest site in the Big John Creek drainage is ongoing, and a Management Area was established as part of the planning for the now cancelled North Irish Reoffer.

Deer populations in the analysis area should be monitored. Population assessments, rather than just habitat evaluation, should be conducted to document the number of deer actually present in the area. This information will provide the baseline information upon which the potential effects of increased wolf predation may be measured, as well as provide the data upon which hunting decisions may be based.

Fish

Road construction and timber harvest can result in impacts to fish resources. Roads can contribute sediment to streams, both through erosion of the road surface and through mass wasting of cut and fill slopes in higher gradient areas. Sediment can reduce the suitability of spawning areas, fill pools and other deep water habitats, and reduce prey populations. Roads also increase public access to fishing areas, which may result in overharvest of fish by anglers. Where there are no buffers, clearcut logging can directly impact streams by decreasing stream shading, which results in increased water temperature, or by reducing the number or size of trees that can be recruited into the stream as large woody debris (LWD). LWD provides cover for fish, retains sediment, and tends to produce pool habitats. Removal of streamside trees can also reduce bank stability, thereby increasing bank erosion and channel migration. Indirect impacts of clearcutting involve changes in soil stability and hydrology. Tree harvest can reduce soil stability, leading to mass wasting events that deposit sediment in streams. Changes in interception, transpiration, and snow accumulation can alter the timing of peak or base flow runoff in harvested areas. These changes in hydrology can cause flooding in stream areas. Hydrological impacts related to harvest are

discussed in the watershed section of this chapter. The remaining impact types are discussed individually below.

Temperature Impacts

Although all Class I or II streams have at least 100 feet buffers adjacent to harvest units, between 1.9 and 3.9 Class III stream miles would occur within harvest units (Table 4-17). Buffer strips are not mandatory for all Class III streams but can be established if resource conditions warrant. Class III streams do not contain fish, so no direct impact to fish would occur in these areas, but harvest along Class III streams would remove shade producing trees resulting in possible water temperature increases. These increases in water temperature could affect fish-bearing waters immediately downstream of the affected Class III streams. However, because the length of streamside harvest never exceeds 2.1 percent of the total stream mileage within a watershed, increases to stream temperatures within harvested areas are not expected to significantly affect temperatures in the remaining portions of each stream system. Any temperature increases within harvested areas represent a short-term impact that would be eliminated in 4-5 years as new vegetation grows and provides shade to streams within harvested areas.

Table 4-17
Miles of Buffered Class I and II Streams Near Harvest Units and Miles of Class III Streams Within Harvest Units

Alternative	Buffered One Side Classes I and II	Buffered Both Sides Classes I and II	Within Harvest Unit Class III
2	3.0	0.5	3.86
3	1.9	0.2	1.93
4	1.6	0.2	3.06
5	2.3	0.2	2.49

If temperature increases in harvested areas did affect the temperatures within mainstem areas of the Castle River and Tunehean Creek, significant adverse impacts could occur. Existing evidence suggests that water temperatures in these mainstem areas already exceed optimal levels for salmonids. Additional temperature increases could lead to mortality, resulting in reduced numbers of coho salmon and steelhead trout, which reside in streams for 1-2 years before migrating to the ocean. Reduced numbers of these fish, in turn, could affect the distribution and abundance of their predators (e.g., otters, Stellar sea lions, etc.). Alternative 2 has the greatest amount of unbuffered stream length, followed by Alternatives 4, 5, and 3. The extent to which harvest would increase water temperatures is unknown, but, as noted above, the increases are not expected to be significant to fish. Alternative 1 proposes no harvest and would have no effect on water temperatures.

Sediment Impacts

Streamside harvest and road construction could both result in increased sediment levels within streams. Sediment impacts of streamside harvest involve increased bank erosion and the lack of an undisturbed buffer to filter sediment from upland areas. Sediment increases are expected with Alternative 2 having the greatest impact, followed by Alternatives 5, 4 and 3 in descending order. Alternative 1 would have no effect on instream sediment levels. Field visits to streams in existing harvest areas on Kupreanof Island (North Irish Timber Sale) did not reveal evidence of substantial

sediment increases, however. Consequently, if suggested mitigative measures are implemented, sediment impacts from streamside harvest should be minimal regardless of which alternative is selected.

Roads contribute sediments to streams in two ways. First, rainfall on roads is concentrated and directed off the road surface using ditches and culverts. Depending on the amount of exposed soil, total water volume, etc., this runoff can carry sediment to streams. Secondly, mass wasting of sediments from cut and fill slopes can deliver large quantities of sediment to streams. Sediment from roads can be a long-term impact (Burroughs and King, 1989; Megahan, 1974). Alternative 2 has the greatest total road mileage (Table 4-18), and therefore sediment inputs from road related erosion are expected to be greatest under this alternative. Road related sediment inputs would be similar under Alternatives 4 and 5. Alternative 3 proposes fewer road miles and has a correspondingly smaller potential for sediment problems. Alternative 1 involves no road construction and would not result in road related sediment inputs. Additional discussion of road related sediment is presented in the watershed section.

Table 4-18

Miles of Roads and Number of Stream Crossings by Action Alternative

Alternative	Road Miles	Stream Crossings Class I	Class II	Class III	Total Crossings	Total Class I & II
2	48.6	7	29	61	97	36
3	27.9	4	21	32	57	25
4	39.6	5	24	36	65	29
5	38.6	6	24	38	68	30

Fish Passage

Roads could impact fish populations by blocking fish passage at stream crossings, a short-term impact for temporary roads and long-term impact for permanent ones. The objective for Class I and II streams is to maintain the natural migration of adult and juvenile anadromous and resident fish populations where economically feasible (USDA Forest Service, 1986). Culverts are typically used for road crossings of smaller streams, whereas bridges are used for larger streams and rivers. Bridges will be considered for stream crossings when acceptable fish passage can not be maintained by culverts. If bridges and culverts are not properly designed they can clog with debris, become "perched" (i.e., elevated above the downstream water surface), or funnel stream flow causing high water velocities. These conditions limit or prevent fish movement through the stream crossing structure.

The total number of proposed stream crossings, as well as crossings of Class I and II streams, is greatest for Alternative 2, and therefore the potential to impact fish passage is greatest for this alternative (Table 4-18). The number of proposed road crossings are similar for Alternatives 4 and 5. Consequently, the potential of these alternatives to impact fish passage is similar. Alternative 3 proposes fewer stream crossings and has a correspondingly smaller potential for fish passage problems. Alternative 1 involves no road construction and would not result in fish related passage barriers.

Fishing Access

Roads also could impact fishes within the Shamrock area by increasing public access to fishing areas, a long-term impact. Increased access could lead to increased angling pressure, which could reduce the average size or population density of resident fishes, or the number of spawning individuals of anadromous fish species. With the exception of Irish Lakes, which are accessible by floatplane, the interior portion of the Shamrock area currently can be reached only by helicopter or by foot. Alternative 2 has the greatest road mileage (Table 4-18), and therefore has the greater potential to increase fishing access. The level of expected impact for the remaining harvest alternatives is greatest for Alternative 4, intermediate for Alternative 5, and least for Alternative 3. Alternative 1, the no action alternative, would have no effect on public access.

Cumulative Effects

Alternatives that affect larger watershed areas have a greater potential to impact fish. In the same way, past or future timber harvest activities, combined with the current proposed sale, have a greater effect on fish resources than would be expected from any of the current alternatives alone. This combination or cumulative effect is largely restricted to areas within watersheds because fish in one drainage are usually unimpacted by changes in other drainages. An exception to this is public access and the potential for overharvest. Overharvest in one watershed can lead to increased fishing pressure in adjacent watersheds that have larger fish populations. The cumulative effects of public access are best addressed on a larger unit of scale, such as groups of watersheds.

A small portion of the Big John Drainage was harvested as part of the North Irish Timber Sale. The remainder of the Shamrock area is currently roadless and unharvested.

The cumulative effect of the Shamrock Timber Sale and previous North Irish Creek Timber Sale would be to increase sediment inputs to Big John Creek. This could affect habitat quality, especially trout spawning areas in the upper reaches and salmon spawning areas in lower reaches. Temperature increases could also occur, however, it

Small streams in the Shamrock area provide habitat for resident fish species.

is not known if Big John Creek has temperature sensitive sections. A major cumulative effect of these sales is to increase public access to fishing areas in the Shamrock area, increasing the potential for overharvest of fish. The North Irish Creek Sale provided road access from the community of Kake to the northern boundary of Shamrock. All action alternatives would extend this road south and east into the drainages of the Castle River, Keku Creek, Tunehean Creek, and the creek referred to as Unnamed 1. The small human population and large number of fishable rivers on Kupreanof Island, however, make it unlikely that substantial overharvest would occur, except in localized areas (e.g., Irish Lakes).

Mitigative Measures and Monitoring

Buffer Strips

One approach to lessen many of the potential impacts discussed above is to prohibit timber harvest from areas adjacent to streams, ponds and lakes. By preserving streamside trees, these buffer strips greatly reduce concerns about elevated water temperatures, LWD depletion, or increased bank instability due to harvest. Buffer strips can also reduce sediment inputs by acting as filters or barriers to sediment from adjacent areas. The Tongass Timber Reform Act (TTRA) mandates the use of minimum 100-foot wide buffer strips along both sides of all Class I streams and all Class II streams that flow directly into Class I streams. All Class I and II streams and their associated buffers are outside harvest units planned for the Shamrock area (Table 4-17). Class III streams do occur in harvest units and would not be mitigated with buffer strips. Setting boundaries within harvest units have been designed to minimize bank disturbance and in-channel activity on Class III streams not protected by buffer strips.

Wind may negatively affect fish habitat when large numbers of trees are blown into streams blocking fish passage or when streamside shade is removed by blowdown. However, natural blowdown is also one of the principal mechanisms for introducing LWD into stream channels. In many circumstances LWD can improve fish habitat by decreasing water velocity, filtering sediment, and creating pool habitats. Streams in the Shamrock area with heavy concentrations of debris are often excellent producers of coho salmon. Consequently, limited areas of blowdown, which are inevitable, are not expected to compromise the quality of fish habitat in the Shamrock area. Large scale blowdown that could negatively affect fish is reduced or eliminated by avoiding harvest near fish-bearing waters.

Temperature

Buffers provided along Class I and II streams are expected to prevent adverse temperature increases.

Sediment

Sediment impacts from bank erosion are mitigated by reducing bank disturbances and preserving riparian vegetation. Buffer strips are effective in reducing or eliminating changes in bank erosion. In unbuffered areas, split yarding techniques, felling trees away from streams, and stabilization of disturbed areas following harvest can all reduce, but not eliminate, bank related sediment inputs.

Mitigation of road related sediment requires proper road design. Road BMPs require erosion control features such as water bars and sediment retention structures (USDA Forest Service, 1991b; 1993c). Use of these BMPs should reduce most road related

Analysis of fish habitat in the Castle River drainage

sediment inputs to streams in the Shamrock area. Additional discussion of this impact is provided in the watershed section.

Road construction restriction periods will be observed to protect fishery resources. These restrictions ensure that streams are undisturbed during critical life history stages including migration, spawning and egg incubation. Guidance provided by ADF&G indicates that restrictions on road construction in Class I or Class II and III streams in close proximity to Class I streams should occur during the period August 1 - June 15 in coho salmon areas, July 15 - May 15 where pink and chum salmon occur, or March 1 - July 18 in steelhead areas (Cornelius, 1993). Should overlapping restriction periods result in no available period for instream construction activities at specific sites, these restriction periods could be modified upon consultation with ADF&G. Pink and chum salmon spawn primarily in estuaries and the lowest portions of rivers. None of the action alternatives propose road crossings in these types of stream areas. Consequently, construction restriction periods for coho salmon and steelhead should be used as guidance for all road construction.

Fish Passage

Fish passage problems can be mitigated through the use of properly designed culverts and bridges. The Forest Service has developed several documents to provide guidance on BMPs to avoid passage problems. Both the Soil and Water Conservation Handbook (USDA Forest Service, 1991b; 1993c) and the Aquatic Habitat Management Handbook (USDA Forest Service, 1986) provide specific direction on culvert construction, placement, and erosion reduction at crossings. If culverts and bridges are constructed according to these BMPs, then fish passage at road crossings should not be impaired.

Fishing Access

Mitigation of increased public fishing access can be accomplished by closing roads to vehicular traffic after timber harvest is completed. Alternately, the potential for overharvest can be reduced through the use of fishing regulations that limit take, legal fishing gear, seasons, etc. Although fishing pressure is likely to increase if roads are constructed, the relative remoteness of the Shamrock area, even with increased road access, makes it unlikely that overharvest would occur. Consequently, mitigation of public access is not recommended unless monitoring efforts suggest deleterious effects of angling on fish populations (see below).

One area that may warrant special protection from overharvest is Irish Lakes. The easy access from logging roads and reputation for abundant fish populations are likely to lead to extensive fishing pressure in this area. Specific management regulations (e.g., management as a trophy fishery) are available to prevent potential overharvesting in Irish Lakes.

Monitoring

Monitoring is required to ensure that BMPs to protect beneficial uses are both implemented and effective (USDA Forest Service, 1991b; 1993c). Propagation of anadromous and resident fishes is a major beneficial use of streams and rivers in the Shamrock area. Relevant BMPs to protect this beneficial use include: establishment of buffer strips, stabilization of disturbed streambanks, use of properly designed bridges and culverts, timing restrictions for construction activities, installation and maintenance of erosion control structures, control of road drainage, and road surfacing to reduce erosion. Monitoring to ensure implementation would involve site visits by Forest Service employees or their representatives to timber harvest or road construction sites during timber sale activities. Additional visits after harvest activities are completed may also be required if the BMPs require post-harvest activity (e.g., maintenance of structures).

If monitoring indicates that BMPs are not preventing degradation of water quality and fish habitat, then additional corrective actions should be identified and implemented. Monitoring results should be summarized and presented in an annual report. This report should identify relevant BMPs, indicate whether they have been implemented, and specify their effectiveness in protecting water quality and fish. If additional corrective actions have been implemented, they should be identified and their effectiveness assessed.

Enhancement

The primary enhancement opportunity is the installation of fish passage facilities where migration barriers currently exist. Candidate sites include falls located on Tunehean Creek, Big John Creek, and Unnamed 1. The height (> 10 feet) and remote location of these barriers, however, suggests that installation of passage facilities would not be feasible and/or cost effective at this time. None of the barriers are near proposed harvest units.

Biodiversity

Reduction of biodiversity as a result of timber harvesting has recently become a major concern for forests in Southeast Alaska, as it has for forests throughout the world. The loss of ecosystem characteristics unique to large, contiguous blocks of old-growth forest and the effects on wildlife, fisheries, and TES species richness and abundance

are some of the reasons biodiversity is an issue for timber harvesting in Southeast Alaska. General concerns about biodiversity raised by numerous individuals in the scoping process for the proposed Shamrock timber sale centered on the cumulative loss of forest ecosystems in the region and on Kupreanof Island. More specific concerns were expressed by the ADF&G regarding loss and fragmentation of old-growth and the disproportionate harvesting of high-volume stands of timber, which have structural features that are important to many wildlife species.

In response to these concerns raised during scoping, this analysis will focus on aspects of biodiversity related to old-growth forests and old-growth dependent wildlife, although biodiversity also encompasses other attributes of these ecosystems and their component animal and plant species. These other biodiversity elements are addressed to a minor extent here because they are also discussed in the wetlands, fish, TES plants, and wildlife sections of Chapter 4.

Loss of Old-Growth Forest

The amount of forest harvested in each of five volume classes and the degree of fragmentation resulting from harvesting were quantified to assess the effects of each alternative on old-growth. The amount of old-growth forest to be harvested for the various alternatives is slightly less than the total harvest acreage because of small inclusions of non-forest lands within harvest units. Alternative 2 results in the greatest harvest of old-growth (2,537 acres), Alternative 3 has the least harvest (1,071 acres), and Alternatives 4 and 5 are intermediate in the amount of harvested old-growth. The proposed alternatives would result in losses ranging from 2.4 to 5.7 percent of the total old-growth forest now present in the Shamrock area (Table 4-19).

Another way to evaluate the effect of harvesting on old-growth is to determine the amount of interior old-growth forest remaining. A harvest unit within an old-growth block not only removes an equivalent area of old-growth, it increases the amount of "edge" between old-growth and open areas and results in a decrease in the amount of interior old-growth habitat. Since many wildlife species primarily utilize interior old-growth, it may be a more sensitive indicator of harvest impacts on old-growth dependent species than direct reductions of old-growth area.

Interior old-growth is typically considered to be the forested area inside of a 300 foot buffer measured from the outside edge of a given old-growth block and from any inside edges created by open areas within an old-growth block (e.g., patches of muskeg or harvest units). Based on this definition, an analysis of remaining interior old-growth after harvest was conducted for the four action alternatives. The results of this analysis indicated that the percentage decrease in interior old-growth forest would be generally about double that of old-growth lost to harvest alone, ranging from 4.5 percent for Alternative 3 to 11.3 percent for Alternative 2 (Table 4-19).

Fragmentation of Old-Growth Forest

There would be a small degree of fragmentation for existing blocks of old-growth forest from each of the action alternatives proposed for the Shamrock area (Table 4-20). Alternatives 2 and 5 would result in the highest and Alternative 3 the lowest degree of fragmentation. Effects of roads on fragmentation could also occur, but they were not included in this analysis. Road corridors were not considered wide enough to separate blocks of forest into ecologically significant segments.

There are six blocks of contiguous old-growth in the Shamrock area that are greater than 1,000 acres (see Chapter 3 biodiversity section for discussion of old-growth block). Under all of the action alternatives, these six blocks would be retained but there would be some reduction in the size of these blocks. The largest reduction, common to all alternatives, would be a 17 to 18 percent reduction in one 4,420 acre

Table 4-19
Areas of Old-Growth Forest Remaining

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
All Old Growth[1]					
Acres	44,405	41,868	43,334	42,778	42,596
Percentage Decrease	0.0	5.7	2.4	3.7	4.1
Interior Old Growth[2]					
Acres	31,253	27,730	29,848	29,089	28,763
Percentage Decrease	0.0	11.3	4.5	6.9	8.0

[1] Old-growth forest is defined as all areas coded as Stand Size Class 4 in timber type data layer of GIS database.
[2] Interior old-growth forest is defined as all old-growth inside of a 300 foot buffer measured from the perimeter and from any interior edges (e.g., a harvest unit within a block).

Table 4-20
Size Distribution of Contiguous Old-Growth Forest Blocks in Shamrock Area for Each Alternative[1]

	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Block Size	Number of Blocks	Acres	Number of Blocks	Acres	Number of Blocks	Acres	Number of Blocks	Acres	Number of Blocks	Acres
< 100 acres	139	2,677	177	2,906	160	2,786	171	2,889	187	2,924
100-500 acres	12	2,076	12	2,288	12	2,287	12	2,288	12	2,288
501-1,000 acres	0	0	0	0	0	0	0	0	1	504
> 1,000 acres	6	39,650	6	36,675	6	38,259	6	37,602	6	36,881

[1] Old-growth forest block is defined as a group of contiguous polygons in the GIS database coded as Stand Size Class 4 in Timber Type data layer of GIS database (sawtimber ≥ 9 inches diameter and ≥ 150 years old).

block. The main difference among alternatives would be a 1 percent (Alternative 3) versus a 10 percent (Alternative 2) reduction in a 18,525 acre block.

In contrast to this loss of old-growth occurring in relatively large blocks, there would be an increase in the amount of forest occurring in smaller blocks. Most of the increase would be in blocks of less than 100 acres, although the total increase in old-growth forest in this size class would be relatively small (maximum of 250 acres under Alternative 5).

This decrease in the amount of forest in large sized blocks and corresponding increase in the area occurring in smaller blocks would result in a minor loss of habitat value for old-growth dependent species. Quantification of this reduction in habitat value is incorporated into the results of the habitat capability model analysis for five MIS (discussed in the following sub-section and in the Chapter 4 section on wildlife).

Effects on Wildlife Habitat and Populations

Sitka black-tailed deer, marten, and black bear were MIS selected for use in assessing effects of harvest activities on biodiversity. Results of habitat capability models conducted on these species indicate that there would be relatively small reductions in overall habitat suitability and corresponding carrying capacity (see section on wildlife for thorough discussion). For Sitka black-tailed deer 1-25 years post-harvest, there would be estimated reductions of 2.0 (Alternative 3) to 5.6 percent (Alternative 2) in "average" habitat ($0.3 < \text{HSI} \leq 0.7$). Since there was estimated to be no "good" habitat ($\text{HSI} > 0.7$) for this species in the existing conditions, "average" habitat represents the highest quality of habitat available to Sitka black-tailed deer in the Shamrock area. For marten, there would be an estimated 2.7 to 7.5 percent reduction in "good" habitat and an additional decrease of 2.2 to 5.2 percent in "average" habitat, with Alternatives 2 and 3, respectively, representing the highest and lowest decreases. There are expected to be losses of 2.3 to 5.8 percent "good" habitat for black bear and small increases of "average" habitat, ranging from 1.6 percent for Alternative 3 to 4.2 percent for Alternative 2.

Effects on Other Biodiversity Elements

There would be little effect on habitat types other than forests that would result from harvesting in the Shamrock area. A relatively small amount of muskeg would be lost due to construction of roads and log storage facilities. No harvesting or road building activity is expected to occur in estuarine, beach, or subalpine habitat. Some riparian areas would be impacted where roads cross streams, but use of BMPs should minimize these effects.

Some impacts to fish habitat and populations could occur from sediment impacts, possible increases in water temperature, and increased public access. Impacts are, however, not considered great enough to substantially diminish this resource and, thus, would not be expected to have noticeable secondary effects on wildlife populations that depend on fish.

No effects on TES plants are expected to occur under any of the alternatives. One species that is considered rare in the region, Menzies' spiraea, occurs in riparian habitats and could be impacted by road crossings of streams, although planned mitigation for riparian areas should minimize potential impacts. This species is considered rare in Southeast Alaska because it is at the far north end of its geographic range, but was judged to be relatively common in the Shamrock area.

Although a northern goshawk nest is known to be in the Shamrock area, effects of activities on this species should be limited to a small reduction in goshawk foraging area. Marbled murrelets occur throughout the area, and harvesting may result in some loss of nesting habitat for this species.

Cumulative Effects

Cumulative effects on biodiversity should be examined on the scale of Kupreanof Island as a whole, since populations and ecosystems within the Shamrock area are continuous within this larger geographical area, and the island is functionally a distinct ecological unit. Because much of Kupreanof Island is composed of land of LUD IV (Timber Production), increased harvesting of forests on the island is expected to occur over the next 50 years. Consequently, cumulative effects of the Shamrock harvest should be considered in association with continued harvesting over a 50 year

timeframe, as well as with previous and currently planned sales on Kupreanof Island. However, future sales have only been planned for the next ten years.

Most of the relatively limited harvest to date occurred in the northern portion of the island and in scattered areas along the southern coast. Since 1981, several Forest Service timber sales have occurred on Kupreanof Island totaling about 300 MMBF (Table 4-21). An additional 161 MMBF are tentatively planned to be harvested in Forest Service timber sales over the next decade. In addition, cumulative harvest to 1994 on Native lands of Kupreanof Island total 14,374 acres. Data on the volume of timber harvested from Native lands are lacking, but this harvested area indicates that total volume harvested on Native lands on Kupreanof Island to 1994 is at least that of the Forest Service harvest, which was 10,000 to 11,000 acres.

The volume of timber that would be harvested from the Shamrock area under Alternative 5, the preferred alternative, would be an approximately 13 percent increase in harvested volume compared to previous harvest on Kupreanof Island (not including Native harvests and past harvests in coastal areas). Proposed harvest from the Shamrock area would comprise 7.4 percent of the total past and planned harvested volume on the island from Forest Service timber sales. The proposed harvesting represents the first major incursion of timber cutting in the Shamrock area.

Expected harvests over a 50-year time frame would cumulatively result in substantial loss and fragmentation of old-growth forest over much of the island. Effects of the Shamrock sale would comprise only a small proportion of these long-term, island-wide effects, but the harvest would be representative of the many smaller scale actions that would contribute to landscape-level effects. Of particular concern are effects of fragmentation.

Fragmentation of old-growth blocks has little effect in small degree, but as it increases to moderate levels (e.g., around 25 percent of total forested area), diversity of old-growth related species appears to reach a threshold and decreases sharply (Franklin and Forman, 1987). Much of the Shamrock area is characterized by a mosaic of forest and muskeg, and thus has a relatively high degree of natural fragmentation of old-growth forest. It is not known how species diversity would respond to further fragmentation caused by harvesting. Populations of some old-growth dependent species on Kupreanof Island may respond differently than those on other islands in Southeast Alaska, such as Prince of Wales Island, where muskeg is not as abundant and forests are more continuous. It is possible that, given the existing naturally high level of fragmentation, the area may be closer to the threshold for a sharp decrease in species diversity.

One concept regarding landscape-level effects of extensive timber harvesting is that fragmentation dispersed over many watersheds is less desirable than a concentration of effects within one or two watersheds (Franklin and Forman, 1987; Schoen et al., 1988). Although such a concentration can be detrimental if, for example, erosional effects result in severe deterioration of stream water quality, increasing the degree of fragmentation in one area eliminates the broad distribution of effects across the landscape. The distribution of harvest units under the proposed alternatives for the Shamrock timber sale vary considerably. Harvest units under Alternative 3 are located primarily in two watersheds: the Big John Creek drainage (which has previously been entered in the North Irish sale) and the drainage of Unnamed 1 creek. Under other action alternatives, several units are located in the Castle River and Tuneahan Creek drainages. Thus, effects of harvesting would be more broadly distributed across the landscape for Alternatives 2, 4, and 5, although the degree of fragmentation of old-

Table 4-21
Forest Service Timber Sales on Kupreanof Island[1]

Current and Past Timber Sales

Sale Name	Status	Volume (MMBF)	Area (acres)	Roads (miles)
Hamilton Creek South	Completed 1981	31.0	--	--
Portage-12 Mile	Completed 1984	48.7	2,327	19.2
Todahl	Completed 1991	36.2	1,081	17.1
Toncan	Completed 1992	56.4	1,501	18.7
Tonka Mountain	Completed 1992	55.5	1,692	32
Missionary	Completed 1992	4.5	213	--
White Alice Salvage	Completed 1993	2.1	87	--
North Irish	Partially Completed 1993	47.2	1,775	39
Combination	Completed 1994	10.4	590	3
Portage Bay Salvage	Completed 1994	6.0	147	--
Subtotal		**298.0**		

Tentatively Planned Timber Sales

Sale Name	FY Planned	Estimated Volume (MMBF)	Area (acres)	Roads (miles)
Shamrock[2]	Planned 1996	39.2	1,948	38.6
Bohemia Mountain	Planned 1995	34.3	1,381	27.1
South Lindenberg	Planned 1997	15.0	--	--
South Lindenberg II	Planned 1997	17.0	--	--
South Lindenberg III	Planned 1997	20.0	--	--
Scott Peak	Planned 1999	10.0	--	--
South Kupreanof	Planned 2001	15.0	--	--
South Kupreanof II	Planned 2002	10.0	--	--
Subtotal		**160.5**		
TOTAL		*458.5*		

Source: Gunther, 1992

[1] Does not include past harvests in coastal areas, small planned sales, possible salvage sales, or ongoing harvests on Native lands.

[2] Assumes selection of Alternative 5, the Forest Service preferred alternative. Includes planned Clover Sale.

growth within these watersheds would be relatively low from the Shamrock harvest alone. If future harvesting in the analysis area is also distributed over several watersheds, however, the degree and extent of fragmentation would increase substantially.

Because the Shamrock area is in the central portion of Kupreanof Island, timber harvest in this area affects the distribution of populations between the north and south portions of the island. For example, extensive fragmentation of old-growth blocks in the central portion of the island could disrupt the linkage of remaining old-growth habitat in the north and south portions of the island. Cumulative effects of extensive long-term harvesting on Kupreanof Island would eventually preclude the development of Habitat Conservation Areas (HCA), which are large blocks of old-growth forest left relatively undisturbed. HCAs are part of a conservation strategy recommended by an interagency committee on maintaining viable populations of old-growth dependent wildlife species (Suring et al., 1992). Although areas along the western coastline of Kupreanof Island and northeast of Duncan Canal have LUDs that allow little to no timber harvest, these areas would not be sufficient in themselves to establish a network of linked HCAs recommended by the committee.

Mitigative Measures and Monitoring

Since biodiversity is a landscape issue, mitigative actions specific for biodiversity must also be conducted on a landscape level. Furthermore, effects on biodiversity from timber harvesting are significant primarily when considered on a cumulative basis of several to many harvests in an ecological unit such as Kupreanof Island. Mitigative measures for biodiversity in the Shamrock area must thus be implemented within the larger context of long-term harvesting over the entire island.

Alternative Silvicultural Methods

Some silvicultural methods recently introduced in the Pacific Northwest can reduce negative impacts to old-growth aspects of biodiversity. Uneven-aged harvesting and green tree retention preserve some structural characteristics of old-growth forests important for wildlife species. Retention of snags and slash also maintain important structural features of old-growth. These methods are part of a program termed "New Forestry" that has been proposed as an alternative to forestry practices historically dominated by clear-cut harvesting methods (Drushka, 1990; Franklin, 1989; Gillis, 1990; Hansen et al., 1991).

Uneven-aged harvesting is typically accomplished by conducting multiple harvest entries into a unit, with one-half to two acre size cuts for each entry. By mimicking the scale of blow-down disturbance, the long-term result is a forest that is heterogenous in age-structure and corresponding physical structure, similar to a natural old-growth forest. Although uneven-aged silviculture is approved for use in the Shamrock area, its use is not common in Southeast Alaska.

Green-tree retention is another form of partial cutting that allows some large, living trees to remain following harvest. Green-tree retention results in a mixture of tree sizes in the young second-growth forest, thereby preserving some of the habitat features important to old-growth dependent wildlife. The retention of snags and large woody debris also allows important structural features of old-growth forests to be present in second-growth forests, providing critical wildlife habitat features for species such as cavity nesting birds and marten.

Within the proposed alternatives, Unit 40 (common to Alternatives 2, 4, 5) is prescribed for uneven-aged cutting. Portions of several other units have also been

proposed for green tree retention (Units 7, 15, 23, 28, 29, 36, 55, 61, 81) and snag retention (Units 7, 20, 24, 25, 31, 32, 33, 43, 47, 54) to mitigate wildlife and visual impacts. Slash retention (including large woody debris) is recommended as a mitigative measure for wildlife, whenever possible. The implementation of these will help to mitigate long-term, landscape level impacts of biodiversity resulting from continued harvesting on Kupreanof Island.

Partial cutting is proposed at a fairly small scale for the Shamrock sale due to economic constraints imposed by the costs of road construction. Green tree retention and snag retention has also not been proposed on a large scale due to safety concerns associated with cable logging. In future entries into the Shamrock area, fewer economic constraints may be imposed on the use of partial cutting, allowing it to be used on a wider scale. New forestry practices that preserve structural attributes of old-growth forests should be increasingly considered with each future harvest to mitigate biodiversity impacts in the Shamrock area.

Habitat Conservation Areas

Mitigative measures for biodiversity on a broader, landscape scale are also relevant to the Shamrock area. Although landscape scale issues are more effectively addressed at a policy level, which can then be implemented on a project-specific basis, the relative newness of biodiversity as an issue means that policies are evolving rapidly and that management guidelines for biodiversity are in a state of flux. In particular, the report being prepared by an interagency committee on *A Strategy for Maintaining Well-Distributed, Viable Populations of Wildlife Associated with Old-Growth Forests of Southeast Alaska* (draft report currently under review) has recommended the establishment of HCAs that provide reserves of old-growth forest of sufficient size to maintain viable populations of old-growth dependent species (Suring et al., 1992). A network of these HCAs within a mosaic of harvested and unharvested areas would allow for interactions among populations and a much higher likelihood of population viability. In contrast, the Revised Forest Plan has attempted to balance losses of biodiversity with retention of large areas of relatively undisturbed land on a Forest-wide basis, using LUDs to determine the management objective. The interagency committee suggests that this approach, however, may not be effective for mitigating loss of biodiversity. Much of the area under less development intensive LUDs is non-forest land, and the island nature of much of the forest land makes local species more vulnerable to extinction. Since areas having LUDs that allow little harvest are not always sufficiently large or numerous to function as HCAs on each island, the interagency committee recommends a more localized management of old-growth.

As discussed above for cumulative effects, the position of the Shamrock area in the central portion of Kupreanof Island gives it added importance as part of a potential HCA linking the northern and southern portions of the island. Although a landscape-scale mitigative plan for biodiversity on Kupreanof Island has not been developed, it is important to preserve the option of having an HCA that would include much of the Shamrock area. By aggregating harvest units primarily within two watersheds, Alternative 3 provides the greatest opportunity for developing an HCA in the Shamrock area as part of an island-wide biodiversity mitigative plan. However, none of the action alternatives would preclude future establishment of HCA(s).

Monitoring

A monitoring plan for biodiversity in the Shamrock area is most applicable on a multiple entry and island-wide basis to show cumulative effects on fragmentation. The plan would entail tracking harvested units in a GIS database layer that shows the extent of old-growth blocks. In the Shamrock area this layer has already been developed as part of the existing conditions discussed in Chapter 3 (Figure 3-3), and it is a suitable characterization of baseline conditions for comparing subsequent fragmentation from harvests. Concurrent monitoring of old-growth dependent wildlife populations within the area and over the island as a whole would provide a means to compare habitat fragmentation to actual population size. To determine if species diversity is decreasing as a result of timber harvesting, an island-wide monitoring of old-growth dependent species (e.g., Sitka black-tailed deer) should be implemented well before 25 percent of total forested area is harvested, which is a threshold previously identified with a sharp decrease in species diversity (Franklin and Forman 1987). At present no-island wide monitoring program of wildlife or old-growth MIS is in place.

Watershed

Hydrologic modifications associated with timber harvest commonly include alterations in storm peak flows, base flows, annual water yields, and the magnitude and frequency of rain-on-snow related flood events. Certain water quality parameters such as suspended sediment concentrations and turbidity can also be affected. Production of sediment and degradation of water quality are major concerns because of their effects on fisheries resources.

Timber management activities produce three types of watershed effects: direct, indirect, and cumulative. An example of direct effects would be a road-related landslide entering a stream. An indirect effect would be the same landslide terminating on the floodplain, where winter rains could erode fine sediments into the stream. An example of cumulative effects would be sediment entering many streams within a single watershed from the construction of additional roads during successive timber sales.

Direct and Indirect Effects

Hydrology

The major hydrologic effects associated with timber harvest activities are alterations to the storm peak flows, low flows, and annual water yields caused by removing vegetation and building roads. Removing the vegetative cover reduces the amount of rainfall trapped on the plant surfaces and later evaporated back to the atmosphere. Removal also decreases the amount of water drawn up by plants from the soil. The reduction in these two factors (interception/evaporation and evapotranspiration) results in a greater amount of water in the soil during the summer growing season. This would result in greater flows during the summer base flow period and an increase in the annual water yield (total water discharged each year). Removal of vegetation can also result in a greater magnitude of fall and early winter storm peak flows, because less precipitation is required to rewet the soil after the summer growing season. Water that would normally be bound to the soil can thus contribute to streamflows earlier in the rainy season.

The anticipated hydrologic impacts associated with timber harvesting within the Shamrock area under all action alternatives would be small (Table 4-22). The area

Table 4-22

Area and Percentage of Proposed Harvest by Watershed and Alternative

		Alternative							
	Area	2		3		4		5	
Watershed	**(sq mi)**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Big John Creek	13.9	448	5.0	448	5.0	448	5.0	418	4.7
Castle River	32.6	1174	5.6	144	0.7	296	1.4	579	2.8
Keku Creek	36.2	150	0.7	141	0.6	151	0.6	151	0.7
Tunehean Creek	27.7	437	2.5	0	0.0	425	2.4	390	2.2
Unnamed Creek 1	13.9	443	3.0	443	3.0	446	3.0	321	2.2
Unnamed Creek 2	6.0	90	2.4	0	0.0	0	0.0	90	2.3
Totals	**130.3**	**2742**	**3.2**	**1176**	**1.6**	**1766**	**2.1**	**1949**	**2.5**

Note: Acreages derived from GIS database.

harvested within the major watersheds ranges from 0 acres for Tunehean Creek (Alternative 3) and Unnamed Creek 2 (Alternatives 3 and 4) to 1,174 acres (5.5 percent) for the Castle River in Alternative 2. Runoff from clearcut areas due to rain-on-snow events is one of the most important sources of hydrologic impacts resulting from timber harvest. Because of the low percentage of timber acres harvested within watersheds, the potential increase in runoff due to rain-on-snow events is low for ali alternatives.

Increases in storm peak flows typically do not occur until about 20 to 25 percent of a watershed is logged (Harr, 1980). Research suggests that about 35 percent of a watershed can be logged before increases in base flows are observed (Bartos, 1989). Since the percentage of watersheds logged in the Shamrock harvest would be much lower than these levels, increases in storm peak flows and base flows would not be expected. However, annual water yields would increase somewhat as the total area harvested in the watershed increases.

Compacting soils by constructing roads or skidder trails within a watershed can also result in higher peak flows by reducing the infiltration capacity of the soil and thereby increasing the potential for overland flow. However, research indicates that increases in storm peak flows are not expected until about 12 percent of the watershed area consists of roads (Harr et al., 1975). The total percentage of roads within the major watersheds in the Shamrock harvest is much below this level (a maximum of 0.22 percent for Big John Creek in Alternatives 2, 3, and 4); consequently, the amount of roaded area for any of the proposed alternatives is not expected to be high enough to increase peak flows (Table 4-23).

Sedimentation

Sedimentation from surface erosion occurs when the ground has been disturbed, removing the vegetative cover. The most common surface disturbance in timber management is roading and yarding activities. Surface erosion from roads can occur on the driving surface, in roadside ditches, and on side-cast material. The amount of

Table 4-23
Proposed Road Miles, Percentage, and Density by Watershed and Alternative

Watershed	Alternative 2			Alternative 3			Alternative 4			Alternative 5		
	Miles	Percent[1]	Density[2]	Miles	Percent	Density	Miles	Percent	Density	Miles	Percent	Density
Big John[3]	11.0	0.22	0.79	11.0	0.22	0.79	11.0	0.22	0.79	10.0	0.20	0.72
Castle	13.2	0.11	0.41	3.4	0.03	0.10	5.0	0.04	0.15	9.2	0.07	0.28
Keku Creek	5.3	0.04	0.15	3.6	0.03	0.10	5.3	0.04	0.15	5.2	0.04	0.14
Tunehean	8.4	0.08	0.30	0.0	0.00	0.00	8.4	0.08	0.30	6.6	0.06	0.24
Unnamed 1	10.1	0.12	0.44	10.1	0.12	0.44	10.1	0.12	0.44	6.9	0.08	0.30
Unnamed 2	0.9	0.02	0.15	0.0	0.00	0.00	0.0	0.00	0.00	0.9	0.02	0.14
TOTAL	**48.9**	---	---	**28.1**	---	---	**39.8**	---	---	**38.8**	---	---
AVERAGE	---	**0.09**	**0.33**	---	**0.05**	**0.19**	---	**0.07**	**0.27**	---	**0.07**	**0.27**

[1] Percent of watershed area devoted to road construction.
[2] Miles of road per square mile of watershed area.
[3] Does not include roads constructed for North Irish Sale.

erosion from these surfaces depends on many factors, including the amount of usage, slope, type of covering (vegetation, rock, plastic, etc.), and amount of precipitation. The precise impacts from road surface erosion depends on the proximity to streams and whether or not overland flows directly join the sediment source and the stream. The absence of direct connection of overland flows with streams channels greatly decreases the potential for surface erosional effects along streams; however, there still may be important impacts to wetlands, ponds, lakes, or other sensitive land features.

The magnitude of sedimentation effects is directly related to the length of streams within or adjacent to harvest units (defined as within 100 feet of streams), because of the short transport distance for any eroded sediment and the possibility of direct stream disturbance. Turbidity and other sedimentation effects should decrease with increasing distance between harvest activities and the stream channel. Alternative 1 would have no anticipated sedimentation effects because no management activities are proposed. Alternative 2 would have the greatest potential for affecting streams with a total of 6.29 miles of Class III streams within or adjacent to harvest units, which is nearly two and a half times higher than that for Alternative 3 (Table 4-24). Alternatives 4 and 5 would be intermediate in Class III stream length within or adjacent to harvest units. Since all units are outside of 100 foot buffers adjacent to Class I and II streams, direct impacts to these streams are expected to be minimal.

Stream crossings can cause channel erosion when flows are constricted through culverts or bridge pilings. Constricting flows generally increase the water velocity which, in turn, increases the stream power and the erosion potential of the water. During storm flows, eddies created downstream of culverts can erode both stream banks and unprotected road fill. The greater the number of stream crossings the greater the potential for sediment inputs into streams. Field observations in a harvested area immediately north of the Shamrock area, however, did not show substantial deposits of fine sediments downstream from road crossings. The number of stream crossings for the action alternatives ranges from 63 in Alternative 3 to 109 in Alternative 2 (Table 4-18). The greatest number of crossings within a drainage occurs in the Castle River in Alternative 2 (42) (Table 4-25).

Table 4-24
Class III Stream Miles in or Adjacent[1] to Harvest Units by Watershed and Alternative

Watershed	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Big John	0.60	0.10	0.60	0.60
Castle	1.94	0.07	0.62	0.76
Keku	0.11	0.11	0.11	0.11
Tunehean	1.21	0.00	1.18	0.80
Unnamed 1	2.39	2.40	2.40	0.84
Unnamed 2	0.16	0.00	0.00	0.16
TOTAL	6.39	2.68	4.91	3.26

[1] Within 100 feet of harvest unit.
Note: See Table 4-17 for buffered Classes I and II stream miles.

Other Water Quality Impacts

Besides sedimentation effects on turbidity and suspended solids discussed above, other potential inputs that could affect water quality include fuel, oil and grease spills, and effluent from sanitary facilities. Petroleum products may enter aquatic environments during equipment refueling or storage spills. The effect that these spills would depend on the type of product, amount spilled, time of year, and proximity to water. Sanitation facilities for labor or logging camps can result in increased nutrient loading to streams and, if not properly maintained, in risks to human health. The risk of water quality impacts from spills and sanitation facilities is about the same for all alternatives except Alternative 1, where no activities are occurring.

Watershed Sensitivity

Watershed Sensitivity is a Forest Service developed methodology that calculates an empirical rating or score of the relative sensitivity of a watershed to management activities within that watershed. The analysis uses the Stream Reach Inventory and Channel Stability Evaluation (Pfankuch, 1978) and erodibility potential ("K" factors) of soil units within the watershed (McCorison et al., 1988). These data are weighted by stream mileage and watershed area to obtain their importance in the watershed. The weighted stream stability and soil erodibility numbers are then added together and divided by the stream density (stream miles per square mile of watershed area) to obtain the final watershed score. Watershed sensitivity scores from 0 to 149 are considered low, scores from 150 to 234 are moderate, and scores from 235 to 369 are considered high. Watershed scores of 370 and above indicate a watershed is extremely sensitive to management activities.

Unnamed Creek 1 has the highest sensitivity rating at 182 (moderate watershed sensitivity) and would be the most sensitive to management activities in the Shamrock area (Table 4-26). Within the Unnamed Creek 1 watershed, proposed harvesting ranges from 2.2 to 3.1 percent of the watershed area and length of roads ranges from 6.9 to 10.1 miles (Tables 4-22 and 4-23). Alternatives 2, 3, and 4 propose the greatest acres harvested, number of stream crossings, and stream miles adjacent to harvest units within the Unnamed Creek 1 watershed (Tables 4-24 and 4-25).

Table 4-25
Proposed Stream Crossings by Watershed and Alternative

Drainage	Alternative	Stream Crossings Class I	Class II	Class III	Total
Big John	Alt 2	1	3	7	11
	Alt 3	1	3	7	11
	Alt 4	1	3	7	11
	Alt 5	1	3	4	8
Castle	Alt 2	2	7	28	37
	Alt 3	0	2	4	6
	Alt 4	0	2	4	6
	Alt 5	2	6	16	24
Keku	Alt 2	3	3	2	8
	Alt 3	2	3	2	7
	Alt 4	3	3	2	8
	Alt 5	3	3	2	8
Tunehean	Alt 2	0	3	4	7
	Alt 3	0	0	0	0
	Alt 4	0	3	4	7
	Alt 5	0	3	4	7
Unnamed 1	Alt 2	1	13	19	33
	Alt 3	1	13	19	33
	Alt 4	1	13	19	33
	Alt 5	0	9	11	20
Unnamed 2	Alt 2	0	0	1	1
	Alt 3	0	0	0	0
	Alt 4	0	0	0	0
	Alt 5	0	0	1	1

Note: See Table 4-18 for summary of all drainages combined.

Keku Creek has the next highest watershed rating of 171, and is also considered to be moderately sensitive to management activities. This watershed has the lowest harvest acreage, number of stream crossings, and streams miles adjacent to harvest units of any watershed, regardless of alternative. Therefore, effects on the water resources in this watershed would be similar regardless of the alternative selected.

The Castle River has the third highest watershed rating of 162, which is again considered to be moderately sensitive to management activities. Alternatives 2 and 5

Table 4-26
Watershed Sensitivity Score for the Major Watersheds

Watershed	Soil Sensitivity	Stream Sensitivity	Stream Density	Watershed Score
Big John Creek	0.0199	82.7	1.91	158
Castle River	0.0285	84.6	1.92	162
Keku Creek	0.0083	78.6	2.17	171
Tunehean Creek	0.0139	58.9	2.20	130
Unnamed Creek 1	0.0154	82.6	2.21	182
Unnamed Creek 2	0.0427		2.29	

propose the greatest acres harvested, number of stream crossing, and stream miles adjacent to harvest units in the Castle River watershed.

Big John Creek has a score of 158 (moderate). For Alternatives 2, 4, and 5, potential impacts to this watershed would be very similar. Alternative 3 would have fewer effects because of the small stream mileage (0.1 miles) adjacent to harvest units.

Tunehean Creek is the only watershed that has a low rating (130). It would be the least sensitive to timber management activities. Alternatives 2 and 4 would have the greatest impact potential for Tunehean Creek, and Alternative 3 the lowest impact potential of the action alternatives. Stream stability information is not available for Unnamed Creek 2, so a watershed sensitivity score could not be calculated.

Cumulative Effects

Disturbances within a watershed due to management activities can be individually quite small, but may collectively result in larger basin-wide disturbances, or cumulative effects. As these disturbances accumulate, they may change a watershed's equilibrium. Cumulative effects may lead to increased erosion, streamflow, and channel migration. Although there has previously been some timber harvest and road construction in the northwest portion of the Shamrock area associated with the North Irish Timber Sale, the Shamrock harvest would be the first major entry into the analysis area.

Future, as yet unplanned, harvests are expected to take place in the Shamrock area over a 10 to 50 year timeframe. These harvests and associated roads would contribute to greater cumulative effects, although the extent of these effects is presently unknown.

Mitigative Measures and Monitoring

Hydrology

Mitigation of hydrologic changes due to the removal of mature vegetation would occur naturally with vegetative regrowth following harvest. Although the length of time this would take is site-specific, a reasonable estimate is 25 years based on information from the Pacific Northwest. Consequently, no specific mitigative measures are recommended for impacts to watershed hydrology resulting from timber harvest activities in the Shamrock area. To mitigate cumulative changes in peakflows and base flows, however, the area of second-growth vegetation less than 25 years old (termed hydrologically immature vegetation) should be maintained below 25 percent of total watershed area (McCorison et al., 1988; Harr, 1980). Total roaded area should be kept under 12 percent (Harr, 1975) of the basin area for each watershed. Because the Castle River is a very important subsistence and fishery resource, the amount of hydrologically immature vegetation should be kept below about 20 percent of the total area in this watershed (Tables 4-22 and 4-23).

Sedimentation

The potential impacts from roads and stream crossings should be reduced to minimal levels by instituting BMPs for road construction, such as revegetation, rock armoring, and temporary culvert removal, as recommended in the Soil and Water Conservation Handbook (USDA Forest Service, 1991b; 1993c). The potential for harvest impacts should be minimized by instituting BMPs such as falling trees away from streams, using appropriate logging systems, and avoiding unstable areas. To minimize the cumulative effects impacts of roads on watersheds the total area of roads within each watershed should not exceed 12 percent (Tables 4-22 and 4-23).

Other Water Quality Impacts

The potential impacts from timber harvest and associated activities (log storage yards, petroleum, oils) should be reduced to minimal levels by instituting BMPs for water quality recommended in the Soil and Water Conservation Handbook and required contingency plans. These may include refueling away from streams and wet areas, and locating waste treatment facilities away from water.

Floodplains

Floodplains within or proximal to proposed harvest units have been delineated according to the guidelines of the Soil and Water Conservation Handbook (USDA, 1991b). The delineation method classified floodplains into three width classes: Class A (width is less than 25 feet), Class B (width greater than 25 feet but less than 100 feet), and Class C (width greater than 100 feet). The net area of floodplains within or proximal to harvest units is 111.2 acres. The proportional amount of potential harvested acreage in the study area ranges from a maximum of 2.4 percent in Alternative 2 to a minimum of 0 percent in Alternative 1, the no action alternative. The potential impacts of the timber harvest on floodplains would be to increase flood volumes, velocities, and levels through a decrease in evapo-transpiration (caused by removal of the overstory) and an increase in runoff caused by soil compaction during harvest and road-building activities. The low percentage of harvested acres proposed under all action alternatives would result in only minor, localized increases in the amount of water available to streams. The small amount of increase in water that would be available to streams as a result of the harvest and road-building activities is not considered to be of sufficient volume to alter substantially the floodplain classification performed for this study.

Floodplains Impacts

The proposed timber harvest activities would result in changes in the Shamrock area's hydraulic characteristics through increased overland flow and decreased evapo-transpiration within and downstream of drainage basins containing harvest units. These changes consist of an increase in the amount of surface water flowing in creeks throughout the area. The changes would primarily occur during the first five to ten years following harvest. Vegetative re-colonization of harvested areas would gradually modify harvest-related hydrologic changes, eventually returning them to pre-harvest levels. These potential changes in hydrologic characteristics would result in increases in the peak flows of streams in the study area. However, because the total acreage harvested would be small (up to 24 percent of the analysis area), the potential increase in peak flow is not expected to have a measurable impact, given the inherent natural variability in discharge rates.

Cumulative Effects

The five major watersheds within the Shamrock area flow into the ocean without significant input from tributaries located outside of the Shamrock area. Therefore, cumulative effects of future timber sale offerings and subsequent harvests elsewhere on Kupreanof Island would not affect floodplains within the Shamrock area. Cumulative effects of future sales within the analysis area are described in the hydrology section.

Mitigative Measures and Monitoring

The anticipated impacts of timber harvest on floodplains within the Shamrock area under all alternatives are considered to be small. No setbacks for harvest units would be recommended as mitigative measures for the protection of floodplains within the study area. The application of BMPs for stream channel protection are recommended for harvest units and roads that are within floodplains (USDA, 1991b: Sections 12.6, 13.16). Floodplains in all Class I and Class II streams would be protected through 100 foot setbacks recommended in other sections of this EIS (fish and watershed). The potential impacts to floodplains due to road and stream crossing construction should be reduced to minimal levels by instituting BMPs for construction of these facilities as recommended in the Soil and Water Conservation Handbook (USDA, 1991b). These include constructing roads outside or above floodplains, designing temporary stream crossings that will be able to withstand projected flows during the life of the crossing (USDA, 1991b: Section 14.16), and designing permanent stream crossings so that the facility will not create an obstruction to the flow of water during the design flood (USDA, 1991b: Section 14.17). All permanent facilities constructed in the floodplain must be able to withstand design floods without suffering significant damage. Monitoring of these requirements should consist of Forest Service oversight during the preconstruction design of roads, stream crossings, and bridges, periodic site checks during construction, and routine post-construction checks during road maintenance activities.

Soils

Timber harvest activities such as removal of trees, road and landing construction, and rock pit site development may reduce soil productivity and increase the likelihood of accelerated erosion and sedimentation. At the same time, soil productivity, nutrient cycling, and biomass production may actually increase in other harvest areas because of increases in solar radiation and soil warming.

The primary soil resource concern is the potential for mass movement and soil displacement. Consequences from timber harvest are related to the number of acres harvested and the soil hazard class of the harvest units. Soil hazard classes rank the probability of soil erosion, in the form of mass movement, resulting from logging or road building activities. The probability is related to a number of factors such as soil strength, soil wetness, and slope.

Soil Productivity Impacts

Soil nutrients and plant growth are generally restricted to the upper, organically rich layers. Removal or destruction of these layers would have a severely adverse effect on soil productivity and tree growth. Ground disturbance from harvesting practices may also include the compaction and deformation of the soil which may impede soil drainage and thus reduce productivity. Soil would be removed from production by the construction of roads, skid trails, landings, and rockpits. Soil displacement or compaction resulting from harvest practices can result in both a long-term and short-term decrease in productivity. The impacts from road and landing construction would be long-term. However, the soil productivity, soil drainage, and vegetation would not be measurably altered by road construction except for the width of the roadfill itself. Alternative 2 proposes the greatest amount of harvest area and miles of road (2,592

acres and 46.5 miles) followed by Alternative 5 (1,839 acres and 36.4 miles), Alternative 4 (1,656 acres and 37.4 miles), and Alternative 3 (1,066 acres and 25.7 miles). Alternative 1 proposes no harvest and would have no effect on soil productivity.

Soil Erosion Impacts

The dominant erosional process for the Shamrock area is mass movement in the form of landslides and debris avalanches. Vegetation, particularly tree roots, have a stabilizing effect on soils. Clearcutting can decrease this soil holding capability and increase the likelihood of soil movement on steep slopes.

V-notch channels are associated with erosion and sedimentation from the steeper terrain within the Shamrock area. V-notch channels are highly erosive and once established, provide efficient sediment delivery to streams. A major soil resource concern is to reduce sediment input to V-notches. V-notches have a long-term impact since they continue to erode and deliver sediment.

Windthrow is a significant erosion inducing mechanism that disturbs the soil, destabilizes slopes, and often initiates landslides, especially on steep, high hazard slopes. Forested areas adjacent to clearcuts are more susceptible to windthrow. Windthrow is a severe problem when it occurs near V-notches since these drainages efficiently transport the eroded material to important streams. Windthrow is a short-term impact, if landslides are not initiated, since vegetation will rapidly re-establish on these sites.

Soil Hazard Classes

Soils in the low hazard classes are found on the relatively gentle slopes. They are stable in the natural setting and have little probability of movement if disturbed. Moderate hazard soils are generally found on 35 to 75 percent slopes. They are usually stable in the natural setting, but the probability of movement increases if they are disturbed. The soils in the high hazard classes are also typically found on slopes of 35 to 75 percent. They often show signs of instability in the natural setting and are prone to soil movement if disturbed. Extreme hazard class soils are generally found on slope gradients exceeding 75 percent. In the natural setting they often exhibit serious mass movement features such as landslides, slumps, and V-notches. These soils should not be disturbed. Roads can sometimes be built on these areas, however, by locating them on included areas of less steep benches, or by the application of unusual, and often expensive, mitigative measures. These areas are considered unsuitable for timber production and harvesting is usually not conducted.

Timber Harvest and Soil Hazard Class

The probability of impacts to the soil resources is related to the acres of lands harvested within each soil hazard class. Impacts become increasingly probable as more acreage is harvested on soils in the high hazard class. Alternative 2 proposes the largest harvested acres and the largest harvest area on high hazard class soils, while Alternative 3 proposes the least harvested acres overall and the least harvested acres on the hazard soils (Table 4-27). Alternative 1 would result in no acres harvested; therefore no impacts that would increase erosion or reduce soil productivity would be anticipated.

Road Building and Soil Hazard Class

Road construction on steep slopes may increase the susceptibility for landslides. High and extreme hazard soils that are disturbed by blasting of rockpits, road pioneering,

Table 4-27
Acres of Proposed Harvest by Soil Hazard Class[1]

Proposed Alternative	1-Low	2-Moderate	3-High	4-Extreme	Total
Alt 1	0	0	0	0	0
Alt 2	822	1,206	676	0	2,702
Alt 3	365	517	294	0	1,176
Alt 4	556	804	406	0	1,766
Alt 5	655	901	393	0	1,949

[1] Based on inventory soil hazard classes with field verification.

side casting of excavated materials, or other road construction activities have a high likelihood of mass movement when subjected to heavy rainfall. Roads can change natural drainage patterns and cause detrimental changes in soil drainage. Concentrated flows from improperly designed roads can increase the likelihood of off-site impacts such as landslides, increased streambank erosion, and increased sediment delivery. Stream crossings, both temporary and permanent, would have short-term impacts during construction. Improperly designed and maintained roads, including the stream crossings, can have long-term impacts.

Road building impacts are related to the length of road constructed and the soil hazard class in which each segment of road is built. Alternative 2 has the most proposed road miles constructed on high hazard soils and therefore has the highest likelihood of impacts, whereby Alternative 3 proposes fewer road miles (Table 4-28) and has a correspondingly smaller potential for impacts. Alternative 1 proposes no road construction, and would result in no impacts.

Cumulative Effects

Cumulative impacts to soil resources are important primarily on the watershed scale. Since the Shamrock timber sale would be the first harvest in most of the watersheds in the area, cumulative impacts would be limited to affects of this harvest. Although future harvests in the Shamrock area may add to these effects, reconnaissance of previously harvested sites in the Stikine area has indicated that stabilization and revegetation occurs quite rapidly. While some unstable sites, such as V-notches and debris avalanches, can become chronic sources of sediment, most slides or slumps are expected to recover quickly.

In contrast, effects of permanent roads are a long-term impact and future harvests would be cumulative to those of the Shamrock sale. Although road design would maintain existing drainage patterns to the extent possible, permanent road construction typically results in some concentration of runoff which may effect downstream channels. The roads would always be a source of slightly accelerated erosion, and road drainage may continue to de-stabilize critical slopes with extreme and high hazard soils.

Mitigative Measures and Monitoring

Soil Productivity

BMPs designed to protect the long-term productivity of the soil have been applied to all alternatives (USDA Forest Service, 1991b). These recommended BMPs are site specific and have been included on the Unit and Road Design Cards.

Table 4-28
Miles of Proposed Road by Inventory Soil Hazard Class

Proposed Alternative	1-Low	2-Moderate	3-High	4-Extreme	Total
Alt 1	0.0	0.0	0.0	0.0	0.0
Alt 2	29.0	13.3	4.2	0.0	46.5
Alt 3	16.7	6.2	2.8	0.0	24.2
Alt 4	24.4	9.1	3.8	0.0	35.8
Alt 5	23.4	9.8	3.4	0.0	36.6

The interdisciplinary approach was used (BMP 13.2) to determine the appropriate timber harvest unit design that would secure favorable conditions of soil productivity and minimize soil erosion sedimentation. The use of partial suspension cable yarding systems was recommended to reduce the disturbance and displacement of the nutrient rich surface layers. Shovel yarding was designated for appropriate areas with thin and easily disturbed alluvial surface soils (BMP 13.9).

Roads were designed to minimize the impacts to natural drainage patterns, and the length and width of roads have been kept to a minimum (BMP 14.3) when the alternatives were designed. Culvert pipe on temporary roads would be removed and water bars installed at the completion of the intended use of the roads to reduce the generation of sediment (BMP 14.24). Rock borrow pits would be located (BMP 14.18) to minimize sediment production.

Soil Erosion

Timber sale planning, timber harvest unit designs, and the designation of water quality protection needs utilized the interdisciplinary approach throughout the EIS process to ensure that soil erosion concerns and recommendations are addressed. Practices recommended by the interdisciplinary team that would reduce erosion from harvest sites included determining the suitability of shovel logging, protecting alluvial soils, utilizing partial and full suspension yarding systems to minimize soil disturbance, designing and locating log landings for erosion control, appropriate timber sale operations to prevent erosion, and establishing vegetative cover on disturbed areas. Other recommendations to reduce surface erosion include grass seeding, and limiting the operating period of the timber sale.

Proposed harvest and road areas that are within designated extreme hazard zones were excluded from consideration. The recommended practice for roads crossing V-notch channels was to avoid the V-notch entirely, or extensively control road drainage. Road crossings, including those associated with V-notches, include mitigative measures outlined in BMPs 12.6, 12.6a, 14.10, 14.11, 14.12, 14.14, and 14.17. As discussed above, temporary roads will be closed following use.

Site specific recommendations were made by the soils team leader to reduce the impacts from windthrow, especially as an input of sediment to V-notches. As the Unit Design Cards were being developed, the interdisciplinary team identified and designated water quality protection needs (BMP 13.3) which addressed V-notches, boundaries of harvest units, specified roads, and areas of known mass instability.

Minerals

There are no active mining claims or identified high value/high development potential mineral occurrences within the Shamrock area. Thus, construction of roads and the subsequent harvest of timber in the Shamrock area would not cause impacts to the assessment, development, or operation of existing mining interests or high value/high development potential sites.

The development of rock and borrow pits for road construction could expose fresh outcrops of bedrock, previously covered colluvium, or previously unknown placer and/or hardrock mineral occurrences. Any of these events could prompt an increased level of mineral exploration activity. The construction of roads into previously roadless areas would increase public access to the area, also increasing the level of mineral exploration. Similarly, the construction of landing sites and associated clearcut logging could also expose new outcrops, colluvium, or evidence of previously undiscovered mineral occurrences. Proposed harvest units and roads for Alternatives 2, 3, 4, and 5 are located in areas that have no known mineral occurrences and a generally low potential for undiscovered mineral deposits. The probability that the timber harvest-related activities listed above would directly result in the discovery of a previously unknown mineral resource is consequently considered to be low. Therefore, little or no impact to the resources of the Shamrock area is expected with the increase in road use and mineral exploration activities. Alternative 1 proposes no harvest or road construction and would not increase the level of mineral exploration in the area.

Exploration Activity

Most of the exploration activity would occur during the summer months. The timing and level of activity could impact the visual resources of the area by an increase in the frequency of vehicles traversing the roadways and the associated road noise. Increased exploration activity could also disrupt wildlife resources in the area. These impacts are expected to be short-lived on the temporary logging roads, but they would persist for the permanent road as long as exploration continued.

Assuming that the increase in mineral exploration activity is proportional to the amount of roads and rockpits, alternatives with the highest number of road miles and associated rockpits would result in the greatest area affected by mineral exploration. Alternative 2, with the greatest number of road miles (48.6) and rockpits (24), would probably have the greatest impacts. The impacts under Alternatives 4 or 5 would be less than those of Alternative 2 but greater than Alternative 3. Alternative 3 has the least number of road miles (27.9) and rockpits (9), and therefore would pose the least impact to the entire area. Alternative 1, with no roads or rockpits, would pose no impacts.

Cumulative Effects

Other timber sales on Kupreanof Island may allow the permanent road system within the Shamrock area to be connected with other road systems. This could result in a further increase in exploration activity and road use, especially if the road system eventually connects to Petersburg, effectively opening up a direct link between the Alaska State Marine Highway and the interior of Kupreanof Island. Even if this scenario should occur, the cumulative effect of mineral exploration activity within the Shamrock area is expected to be small in terms of absolute numbers of vehicles and people.

Mitigative Measures and Monitoring

Even though road construction may increase access to areas previously accessible only by helicopter, float plane, or foot, the relatively remote location of the Shamrock area on Kupreanof Island makes it unlikely that the absolute increase in mineral exploration activity would cause significant impacts to the resources of the Shamrock area. No measures are recommended to mitigate the potential impacts of increased levels of mineral exploration activity that may occur as a result of the harvest of timber in the Shamrock area.

Air Quality

As indicated in Chapter 3, air quality impacts associated with logging activities are normally produced from planned burnings associated with timber operations. Such burning events are not currently planned in the Shamrock area. Therefore, air quality impacts associated with timber harvesting is largely secondary in nature. The only pollutant of concern is total suspended particulate matter (TSP). The principal source of TSP is fugitive emissions associated with heavy vehicle movement on unpaved road surfaces. A much less significant source is particulate emissions from vehicle exhaust (i.e., diesel engines).

Emissions

Fugitive dust associated with heavy vehicle movement is anticipated to be the greatest source of particulate emissions. When a vehicle travels on an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed.

The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Also, field investigations have shown that emissions depend on correction parameters (average vehicle speed, average vehicle weight, average number of wheels per vehicle, road surface texture and road surface moisture) that characterize the condition of a particular road and the associated vehicle traffic.

Dust emissions from unpaved roads have been found to vary in direct proportion to the fraction of silt (particles smaller than 75 μm in diameter) in the road surface materials. The silt content of a rural dirt road will vary with location. As a conservative approximation, the silt content of the parent soil in the area is typically used. However, tests show that road silt content is normally lower than in the surrounding parent soil, because the fines are continually removed by the vehicle traffic, leaving a higher percentage of coarse particles.

Unpaved roads have a hard nonporous surface that usually dries quickly after a rainfall. The temporary reduction in emissions because of precipitation may be accounted for by not considering emissions on "wet" days (more than 0.01 in. of precipitation). The Shamrock area has a high percentage of such "wet" days.

An analysis of particulate emissions from unpaved roads constructed for the Shamrock sale indicate that air quality impacts would be negligible (Newman, 1993). Natural mitigative features (i.e., precipitation, low soil silt content) have positively contributed to minimizing such fugitive emissions.

Cumulative Effects

Since a negligible effect on air quality is expected for fugitive emissions from vehicular traffic in the Shamrock area, no cumulative effects are foreseen with additional roads for future harvests.

Subsistence

ANILCA Section 810 Subsistence Evaluation

The Alaska National Interest Lands Conservation Act (ANILCA) was passed by the U.S. Congress in December 1980 in the interest of preserving in the public interest large portions of federal land in Alaska. The act set aside millions of acres of land in National Parks, National Monuments, National Forests, National Wildlife Refuges, and other protected units. In furtherance of the act, Title VIII of ANILCA provides for rural residents engaged in a subsistence way of life to continue to do so.

Section 810 of ANILCA directs federal land managers to consider subsistence gatherers when making any changes in the disposition of public lands. Specifically:

> In determining whether to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands under any provision of law authorizing such actions, the head of the Federal agency having primary jurisdiction over such lands or his designee shall evaluate the effect of such use, occupancy, or disposition on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes.

Furthermore, no change in use of federal lands that would cause a *significant restriction in subsistence use* can be put into effect until the federal agency

- gives notice of such a change to federal and state agencies concerned with subsistence;
- holds a hearing in the vicinity of the area involved, and;
- makes a determination that:
    1) the significant restriction of subsistence uses is necessary;
    2) the proposed activity will involve the minimum land necessary; and
    3) reasonable steps will be taken to minimize adverse impacts to subsistence resources.

The following definition of "significant restriction" has been adopted by the Forest Service from guidelines provided by the Alaska Land Use Council (ALUC). According to the ALUC

> A proposed action shall be considered to significantly restrict subsistence uses, if after any modification warranted by consideration of alternatives, conditions, or stipulations, it can be expected to result in a substantial reduction in the opportunity to continue subsistence uses of renewable resources. Reductions in the opportunity to

> continue subsistence uses generally are caused by: reductions in the abundance of, or major redistribution of resources; substantial interference with access; or major increases in the use of those resources by nonrural residents. The responsible line officer must be sensitive to localized, individual restrictions created by any action and make his/her decision after a reasonable analysis of information available.

After completing the necessary consultations, assessing public comment, and making the above determinations, the responsible line officer, in the case of the USDA Forest Service, may then decide whether or not to proceed with the project.

Subsistence Evaluation and Determination for the Shamrock FEIS

This section evaluates the possibility of a significant restriction of subsistence uses in the Shamrock analysis area.

Subsistence Use Areas

The Shamrock study area encompasses Visual Comparison Units (VCUs) 438, 436, and 429. VCU 429 falls within Wildlife Analysis Area (WAA) 5130, and VCUs 436 and 438 fall within WAA 5133. Wildlife and subsistence data are normally analyzed by WAA rather than VCU, and for ease of reference this section will generally follow that convention.

Minor portions of each VCU in the Shamrock analysis area have been documented as historical use areas for subsistence gathering (see the TRUCS-based Subsistence Use Maps, Appendix C). Unit 55 is the only harvest unit associated with the Shamrock timber sale that lies within areas documented as subsistence use areas for deer hunting (TRUCS, 1988). The proposed Shamrock harvest area is in the interior of Kupreanof Island, and the vast majority of documented subsistence use is along the beach fringe, therefore few subsistence resources are gathered where the Shamrock harvest units are planned. Nevertheless, some wildlife migrate widely over the island and may depend on many different areas at different times of the year. Thus a thorough analysis must encompass areas well outside of the documented subsistence hunting areas.

Deer Effects and Evaluation

Because of the importance of deer to subsistence users in Southeast Alaska, and because of the fragile nature of the deer population on Kupreanof Island, Sitka black-tailed deer are discussed separately from other wildlife species, which immediately follow this section on deer.

Methodology for Evaluating Deer Effects

The method used for the subsistence resource evaluation for deer was to compare the modeled habitat capability to the minimum number of deer needed to support the foreseeable subsistence harvest. If the post-timber-harvest habitat of the area is estimated to be capable of supporting a deer population greater than the hunter demand, then it is expected that no restriction of subsistence uses will occur. If however the hunter demand is greater than what the habitat is estimated to be capable of supporting, then a finding of "may restrict subsistence uses" is in order.

Such an analysis is complicated in the Shamrock sale, and for any action on Kupreanof or Kuiu islands, by the closure of the deer season in 1975, because there are minimal

data available to gauge the current level of hunter demand for deer. Predicting subsistence demand is inexact when subsistence deer hunting has been prohibited for almost twenty years. Additionally, the estimated number of deer the area is capable of supporting is based on the population carrying capacity derived from the Habitat Capability Modeling (HCM). This estimate is primarily intended for comparative purposes to evaluate different conditions over the same area and is not intended to be an accurate prediction of the actual number of deer in that area. Because it is the best estimate available, it is used in the subsistence analysis; however, its limitations should be recognized when interpreting the results of the analysis.

The historical deer harvest levels that were used as a basis for this analysis are from the 1960s. These figures were gathered before ANILCA, before subsistence harvest was considered separately from regular hunting, and before Ketchikan and Juneau were excluded by definition from subsistence harvests. Also, the communities in question have grown rapidly since then, and hunter preferences may have changed in unpredictable ways. The Kupreanof Island interior is also being opened up by logging roads, which is expected to shift hunter demand in the area. Despite these uncertainties the analysis that follows uses the best information available on subsistence demand.

Abundance, Distribution, and Competition for Deer

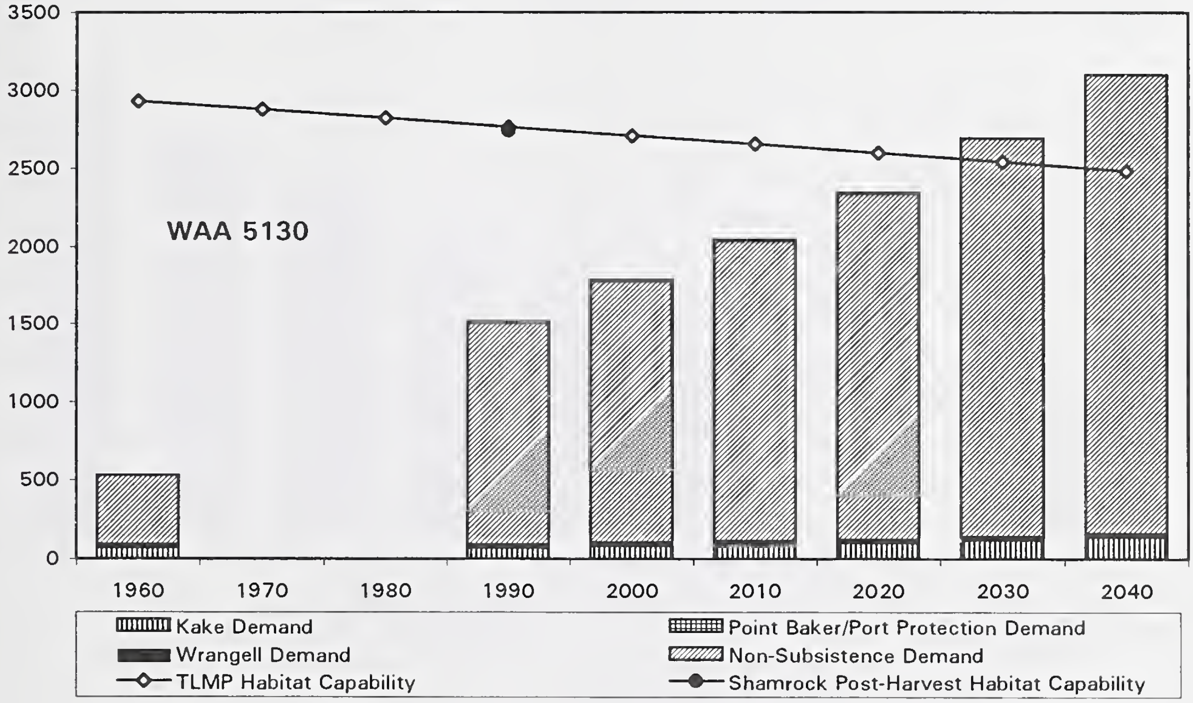
The evaluation of deer for the Shamrock DEIS Supplement is based on a comparison of supply and demand. The habitat capability model for deer, developed as part of the wildlife analysis, provides an estimate of the potential number of deer available for harvest within the project area over time. This equates to a supply available for subsistence use. This potential amount available for subsistence use can be compared with historical harvest data, or demand, for deer. If the demand for deer exceeds the supply, then a significant possibility of a restriction exists. The Alaska Department of Fish and Game stipulates a ten percent sustainable harvest rate for deer (ADF&G, 1991). Thus, the minimum number of deer needed in an area is approximately ten times the subsistence hunter demand for deer, otherwise a restriction on subsistence hunting may ensue.

Habitat Capability

The habitat capability for WAAs 5130 and 5133 were calculated during the Forest Plan Revision process (USDA Forest Service, 1991; Appendix L). The results of this modeling are used for most of the Shamrock subsistence analysis. The habitat capability levels are given for the years 1954, 1990, 2000, 2010, and 2040. The numbers used for the Shamrock analysis are from Alternative P, the preferred alternative. Intervening decades were interpolated using a least-squares regression analysis.

In addition to the Forest Plan Revision information, this Shamrock DEIS Supplement includes the results of modeling changes in deer habitat capability in VCUs 438, 436, and 429 over the next 100 years. The habitat capability for the Shamrock study area was then applied to WAAs 5130 and 5133, to afford comparison between the Shamrock analysis and the Forest Plan Revision estimates. Thus the Shamrock-specific habitat capability was calculated for 1990 through 2090, while the Forest Plan Revision model predicts habitat effects to the year 2040. The Forest Plan Revision habitat capability substantially agrees with the Shamrock habitat capability, and both are included in the subsistence demand graphs in Figures 4-4a and 4-4b. These growth rates are in accordance with the Forest Plan Revision SDEIS and other timber sale EISs in the Stikine Area.

Figure 4-4a
Estimated Number of Deer Needed to Meet Hunter Demand and Estimated Deer Population Carrying Capacity (Habitat Capability) in WAA 5130



The Habitat Capability model population figures are based on Paul (1993), and USDA Forest Service (1991); Appendix L. All figures based on linear regression using above data for 1954, 1991, 2000, 2010, and 2040.

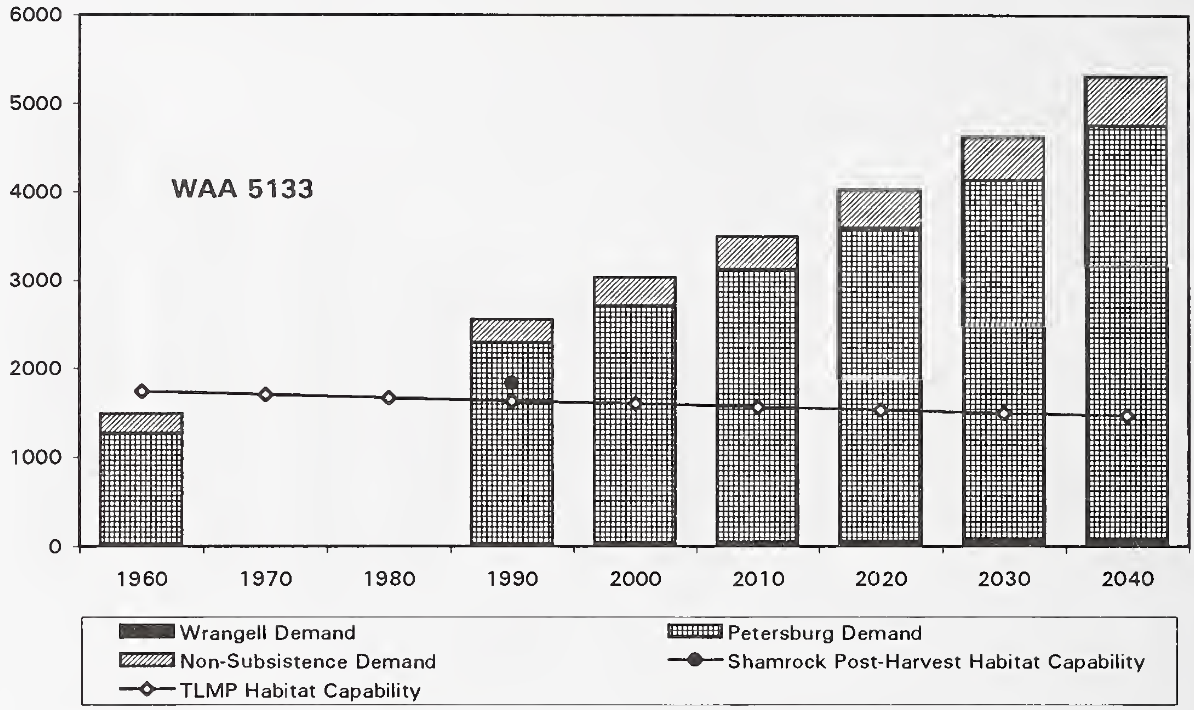
Hunter Demand is from ADF&G (1992), by methods suggested in Doerr (1993). Census data is from U.S. Department of Commerce (1990). Forest Plan Revision assumed 18 percent population growth for 1990-2010 and 15 percent growth for 2010-2040. Hunter demand was assumed to increase at the same rates.

Estimated number of deer needed to meet hunter demand assumed to be ten times hunter demand, according to ADF&G (1991).

Assume 1954 hunter demand for deer was 100 percent subsistence, by methods of Paul (1993).

Hunter demand for Point Baker/Port Protection are included in the column totals but are too low to be distinguished in the figure.

Figure 4-4b
Estimated Number of Deer Needed to Meet Hunter Demand and Estimated Deer Population Carrying Capacity in WAA 5133



The Habitat Capability model population figures are based on Paul (1993), and USDA Forest Service (1991), Appendix L. All figures based on linear regression using above data for 1954, 1991, 2000, 2010, and 2040.

Hunter Demand is from ADF&G (1992), by methods suggested in Doerr (1993). Census data is from U.S. Department of Commerce (1990). Forest Plan Revision assumed 18 percent population growth for 1990-2010 and 15 percent growth for 2010-2040. Hunter demand was assumed to increase at the same rates.

Estimated number of deer needed to meet hunter demand assumed to be ten times hunter demand, according to ADF&G (1991).

Assume 1954 hunter demand for deer was 100 percent subsistence, by methods of Paul (1993).

Populations of Affected Communities

The 1960 census for Kake, Petersburg, and Wrangell totaled 3272 (Table 4-29). Census data were not reported for the communities of Kupreanof, Point Baker, and Port Protection for that year, and those communities have been added to Kake, Petersburg, and Wrangell for analysis in subsequent decades. The census counts for the six study communities totaled 6510 inhabitants in 1990. The community populations were extrapolated using growth rates of 18 percent for the decades 1990 and 2000, and 15 percent for 2020 through 2040.

It is assumed that communities that have historically used the study area for subsistence resources will continue do so in the foreseeable future if the area remains open for deer hunting. The communities of Petersburg, Kupreanof, Kake, Wrangell, Point Baker, and Port Protection could all be affected by any significant changes in subsistence resource availability in the Shamrock area. Hunters from Juneau and Ketchikan formerly hunted on Kupreanof Island, but with the passage of ANILCA in 1980 those hunters are not considered subsistence hunters, and are regulated under State of Alaska hunting regulations instead. The hunter demand graphs (Figures 4-4a and 4-4b) are divided into subsistence and non-subsistence hunter demand. The non-subsistence hunter demand is from the cities of Juneau and Ketchikan. The subsistence hunter demand is from Petersburg, Kupreanof, Kake, Wrangell, Point Baker, and Port Protection.

Hunter Demand

The hunter demand for each community is based on the hunter demand in the 1960s, and the expected demand accompanying the population growth for that community. No hunter demand data are available for the intervening decades because the hunting season was closed on Kupreanof Island between 1975 and 1993.

Table 4-29
Historic and Projected Population for Shamrock Area Communities

City or CDP	1960	1965	1970	1980	1990	2000	2010	2020	2030	2040
Kake	455	452	448	555	700	826	975	1121	1289	1482
Kupreanof	---	---	---	47	23	27	32	37	42	49
Petersburg	1502	1772	2042	2821	3207	3784	4465	5135	5906	6791
Point Baker	---	---	---	90	39	46	54	62	72	83
Port Protection	---	---	---	---	62	73	86	99	114	131
Wrangell	1315	1672	2029	2184	2479	2925	3452	3970	4565	5250
Juneau	6797	6424	6050	19528	26751	31566	37248	42835	49261	56650
Ketchikan	6483	6739	6994	7198	8263	9750	11505	13231	15216	17498
Total	16552	17059	17563	32423	41524	48998	57818	66491	76464	87934

Notes:
Population growth is estimated at 18% for 1900 - 2010 and 15% for 2020 - 2040.
All census figures from US Census 1990, except 1960 column, from Doerr 1993.
Kupreanof population for 1960, 1965, and 1970 is included in Petersburg totals.

The ADF&G (Paul, 1993) estimates an average of approximately 202 deer were killed annually in WAAs 5130 and 5133 in the 1960s (Table 4-30). Much of the demand in WAA 5130 was at that time from residents of Ketchikan and Juneau. Most of the hunter demand in WAA 5133 was from Petersburg. It must be assumed that these deer harvest numbers represent 100 percent of the hunter demand in the 1960s for deer within the Shamrock study area. Because the deer season has been closed on Kupreanof Island since 1975, only a few recent harvest figures are available for comparison. Data compiled by the ADF&G for the 1993 deer season show that 21 deer were taken in WAA 5133 and 0 deer were taken in WAA 5130. The hunter effort expended in these two WAAs was considerably less than that predicted in Figures 4-4a and 4-4b.

Minimum Deer Needed

The ADF&G estimates that about ten percent of a deer population can be harvested if the population is equal to the population carrying capacity predicted by the habitat capability modeling (ADF&G, 1991). Thus, the hunter demand for the affected communities was multiplied by a factor of 10 to arrive at the number of deer that each WAA must support to meet that demand. These are the deer numbers graphed as "Hunter Demand" in Figures 4-4a and 4-4b.

Table 4-30
Deer Harvest by Community, 1960 Estimate

Community	WAA 5130	WAA 5133
Juneau	30	0
Ketchikan	14	22
Kake	7	0
Wrangell	1	2
Petersburg	0	125
Pt. Protection/Pt. Baker	1	0

Source: (Paul, 1993)

Assuming that the historic hunter demand figures in Table 4-30 increase at a rate proportional to the census figures in Table 4-29, the subsistence demand for deer can be extrapolated to the year 2040 to estimate the necessary deer population required to support subsistence needs. The Forest Plan Revision estimates that by the year 2040 WAAs 5130 and 5133 will retain 74 percent and 65 percent, respectively, of the Sitka black-tailed deer habitat capability that those areas exhibited in 1954. This estimate assumes that, under the preferred Forest Plan Revision alternative, approximately seven percent of WAA 5130 and eight percent of WAA 5133 will be harvested over that period (USDA Forest Service, 1991; Appendix K).

Analysis based on habitat capability models allows comparisons with the habitat model run specifically for the Shamrock Timber Sale EIS. The Shamrock analysis predicts that carrying capacities in WAAs 5130 and 5133 are expected to decline by anywhere from 0.5 to 1.9 percent, depending on the alternative chosen. The ADF&G objectives for WAAs 5130 and 5133 are to allow no more than a 22.3 percent reduction in

habitat capability from what exists now. The changes expected as a result of the Shamrock harvest activities are well below that level.

Figures 4-4a and 4-4b graphically show that the habitat capability in WAA 5133 has already been exceeded by hunter demand, and that the habitat capability in WAA 5130 is not likely to be exceeded in the near future. These results were one of the primary reasons for revising the subsistence findings for deer from the Shamrock DEIS to FEIS.

Additional Factors Affecting Hunter Demand

As noted earlier, the Alaska Board of Game did not allow subsistence or sport hunting of deer on Kupreanof or Kuiu islands between 1975 and 1993. This suggests that subsistence users who have traditionally harvested deer on Kupreanof and Kuiu islands prior to the 1975 closure shifted to other nearby areas for the harvest of deer. It also suggests that subsistence hunting may revert to historical patterns now that deer season has been opened on Kupreanof and Kuiu Islands. Other factors that may affect the hunter demand on Kupreanof Island are:

- Deer in WAA 3939 on south Admiralty Island are being harvested at rates higher than the 10 percent recommended by the ADF&G (USDA Forest Service, 1991; Appendix K; ADF&G, 1991). Many Kupreanof Island residents hunt deer on Admiralty Island. Competition from other hunters or a drop in deer availability on Admiralty Island could lead to increased subsistence demand on Kupreanof Island.

- Kake residents have traditionally hunted many of their deer from WAA 5132, on the northwest portion of Kupreanof Island, much of which has undergone extensive timber harvesting since the hunting closure in 1975. A drop in deer population in WAA 5132 could shift some Kake hunters into the Shamrock area for subsistence hunting.

- Roading the interior of Kupreanof Island will provide convenient access to new deer hunting areas, which could increase both the access to and the competition for subsistence resources. The exact effects of roading on hunter demand are unknown.

Most of the deer taken by Kake hunters in recent years have come from south Admiralty Island. Petersburg, Wrangell, and other study-area communities take most of their deer from Admiralty Island, Prince of Wales Island, and the mainland. Information gathered as part of the ANILCA 810 subsistence testimony for the Shamrock DEIS indicate that hunters from both these areas would prefer to shift their deer hunting to Kupreanof Island.

Access to Deer

Access to customary subsistence areas on Kupreanof Island is not expected to be significantly affected by any of the action alternatives associated with the Shamrock timber sale. This is because customary subsistence deer hunting areas on Kupreanof have historically been along the beach fringes and rivers. Access to these areas will not change. However, access to interior deer hunting areas is expected to increase significantly as a result of road building associated with the Shamrock sale.

Presently, the only means of motor vehicle access to the study area is a logging road from Kake which terminates in the northwest portion of the study area. The roads proposed for the Shamrock timber sale will increase access to areas not currently used for subsistence uses, including access by users of the Alaska Marine Highway system.

Since access to the Shamrock area is currently very limited and the proposed road system would allow vehicle access into the interior of the Shamrock area by members of the Kake community and users of the Alaska Marine Highway system, the proposed project will lead to substantially greater access to deer by both subsistence and non-subsistence hunters. No significant restriction in access to deer by subsistence hunters is anticipated.

Deer Findings

Only one of the proposed timber harvest units (Unit 55) being considered in the various alternatives for the Shamrock timber sale is located in an area documented as having been utilized for subsistence deer hunting during the last fifty or more years, before the area was closed to deer hunting. However, other proposed timber harvest units may be important habitat for deer that are hunted elsewhere on the island. The projected effects to deer resulting from harvesting these units are evaluated in the Wildlife section of the Shamrock DEIS.

Based on predictions of the habitat capability model, the carrying capacity of the Shamrock area for Sitka black-tailed deer is expected to decline by 0.5 to 1.9 percent as a result of the Shamrock sale, depending on the alternative chosen. Thus, when considering the deer population, the projected effects of timber harvest on abundance would also be reduced by no more than approximately 1.9 percent in any action alternative. Because of the scattering of timber harvest units, changes in local deer herd distribution are expected to be low to negligible.

Based in part on the habitat capability modeling for the Wildlife section of the Shamrock DEIS and the similar modeling for the Forest Plan Revision this evaluation concludes that a significant restriction of subsistence use of deer already exists in WAA 5133. Although the Shamrock timber sale is not expected to cause a substantial impact to the abundance of deer in the study area, any reduction in abundance will further restrict subsistence use of deer in WAA 5133. The degree of restriction due to abundance can be expected to be directly proportional to the reduction in deer habitat capability. Alternative 3 would have the least restriction, Alternative 2 the greatest, and Alternatives 4 and 5 would be intermediate.

Traditionally, local subsistence users have harvested deer in conjunction with other hunting and gathering activities, and hunting access was primarily via foot and boat. This mode of access is not expected to be restricted, although hunter preferences may change as a result of roading the Kupreanof Island interior. Increased access to the interior portions of Kupreanof Island may result in increased competition between subsistence and non-subsistence deer hunters. The degree of increased competition due to access is expected to be directly proportional to the length of road constructed for each alternative (Table 4-1). Alternative 3 would have the least road milage constructed, Alternative 2 the greatest, and Alternatives 4 and 5 would be intermediate.

Based on a review of the current data available on subsistence harvest in the surrounding areas, and other factors such as roading, this evaluation concludes that there may be a significant restriction of deer due to changes in access or competition

from other hunters in both WAA 5130 and WAA 5133, and due to decreases in abundance in WAA 5133.

Wildlife Effects and Evaluation

Abundance and Distribution of Furbearers

Some trapping occurs on Kupreanof Island as indicated by the harvest of furbearers in ADF&G Minor Harvest Areas (MHA). Proposed harvest units in various alternatives are located in mapped furbearer-subsistence use areas of Duncan Canal (VCU 436 and 438). Fur trapping is credited with much of the original exploration and settlement of Southeast Alaska. While trapping activities have diminished markedly since the 19th century, furbearing animals are still important to the rural communities using the study area.

Small numbers of marten, mink, and river otter are harvested during periods of generally high market demand for pelts. Fox were introduced to Kupreanof on farms. The foxes were often fed in pens but released to the island for maturing. Mink farming replaced fox farming in the 1930s (Smythe, 1988). Trapping was an important subsistence activity in Kake thirty years ago, but is less so today due to substitution by synthetic furs and low market demand (Firman and Bosworth, 1990).

Few of the study communities harvest large quantities of furbearers. Seven percent of Petersburg households harvest furbearers (TRUCS, 1988). Less than one percent of Wrangell households successfully trapped in 1986-1987 (Cohen, 1989). Kake and Point Baker households do not harvest significant quantities of furbearers (TRUCS, 1988).

Marten were chosen as a management indicator species (MIS) for the Shamrock analysis area. The estimated marten habitat capability within WAAs 5130 and 5133 in 1954 was set at 355 animals (USDA Forest Service, 1991d). The estimated habitat capability in 1990 totals 352 animals, an approximate 1 percent reduction. The estimated reduction of marten habitat capability due to the Shamrock timber sale, discussed in the Shamrock DEIS wildlife section, is between 1.9 and 4.9 percent overall, depending on which alternative is chosen. Therefore, significant subsistence restrictions on marten are not expected as a result of any alternative considered for the Shamrock timber sale.

Abundance and Distribution of Black Bear

Kupreanof Island is a popular area for black bear hunting. Black bear harvest has increased since 1981, especially by nonresident (out of state) hunters. On a region-wide scale approximately three percent of households in the Kupreanof Island area harvest black bear (Kruse and Frazier, 1988). Of the six study communities, Point Baker is the most active in bear hunting; approximately 21 percent of Point Baker households harvested an average of 55 edible pounds of bear meat in 1987. Five percent of Wrangell households hunted bear in 1987. Of the 28 black bears taken by Wrangell households in 1987, six were from the Kupreanof Island area; the others were from the Stikine River drainage (Cohen, 1989). Three percent of Petersburg households hunted bear in 1987, zero percent of Kake households hunted bear that year (Kruse and Frazier, 1988).

Timber-related impacts on black bear habitat capability are not expected to significantly affect the population. Projected changes indicate the carrying capacity for bear to decline by 0.6 to 1.5 percent, depending on the alternative chosen (see the

Wildlife Section). The habitat capability model indicates that there is a healthy and abundant black bear population on Kupreanof Island.

Based on the habitat capability modeling cited above, the healthy bear population reported on Kupreanof, and the levels of subsistence bear harvest reported by the TRUCS reports, there is not expected to be a significant restriction on the subsistence use of bear under any alternative.

Abundance and Distribution of Moose

With the exception of two transplants, all moose in Southeast Alaska have migrated from Canada, primarily in the first half of this century (ADF&G, 1991c). During the late 1960s most moose ranges in Southeast Alaska were heavily populated. Deep snow conditions in the early 1970s decimated the moose populations, which are now gradually recovering. Most moose habitat in Southeast Alaska is in the large river valleys on the mainland, with small herds inhabiting the central islands. Moose habitat is associated primarily with riparian vegetation and the successional vegetation following glacial retreat, although clearcut logging in the area has turned conifer stands to early successional shrubs and hardwoods which can provide suitable moose habitat. This forest habitat lasts for about 25 years, after which the second-growth forest canopy closes over and forage is diminished below that which existed before the clearcutting. Some moose wintering habitat has been tentatively identified on Duncan Canal, Keku Strait, and around Portage Bay. Only in the larger river valleys, which are disturbed by periodic flooding, is the moose habitat considered stable (ADF&G, 1991c).

Anecdotal information collected by ADF&G indicate that moose populations on Kupreanof Island and the surrounding areas are expanding. However, the scarcity of information on moose has prevented ADF&G from estimating populations or setting harvest objectives (Land, 1993). A limited, permit-only, moose hunting season was opened on Kupreanof Island by ADF&G for fall 1993. The justification for this hunt was based on an estimate of expanding moose population. Also, the specific antler restrictions prevent harvesting moose that would be a limiting factor to the population (Land, 1993).

Based on the expanding moose population and evidence that clearcutting is beneficial to moose habitat in the short term, no significant restriction to subsistence hunting for moose is expected to result from any action alternative of the Shamrock timber sale.

Access to Wildlife

Access to historic subsistence use areas, which have primarily been along shorelines and lower reaches of rivers, has not been affected by past land-use activities and will not be limited by any of the proposed alternatives in the Shamrock area. This is because traditional access to the areas by boat or float plane would still remain available.

The road construction associated with the proposed timber harvest alternatives would increase access by both subsistence and non-subsistence hunters into areas not traditionally used for subsistence hunting (see the study area Alternative Maps). No restriction in access to wildlife resources by subsistence users is foreseen as a result of the Shamrock timber sale.

Competition for Wildlife

Black bear is the primary wildlife resource other than deer currently being harvested on Kupreanof Island by non-rural and out-of-state residents. There have been no direct comments in the applicable ANILCA 810 Hearing testimony to indicate that competition for black bear by the nonresident hunters and non-rural Alaskan residents is affecting the ability of rural community residents to harvest black bear.

People who testified at earlier Point Baker and Kake Hearings expressed concern that increased competition from loggers for subsistence wildlife resources would affect their ability to harvest those resources. Some black bears are thought to be harvested by Alaska nonresident hunters employed at Kake. Other employees at the logging camp at Kake may have met residency requirements and qualify as subsistence users.

The Forest Service is sensitive to the concerns expressed in past and recent ANILCA 810 testimony and has endeavored to accommodate the needs of the rural communities utilizing the study area. There could be an increase in short term competition from individuals associated with the Shamrock area facilities. However, this possible increase in competition is not projected to be substantial or long-term because of the limited number of people potentially involved and the seasonal availability of resources for harvest.

Wildlife Findings

Based on the habitat capability model results, the limited subsistence use of wildlife other than deer, and the difficulty of access to most of Kupreanof Island for hunting purposes, this evaluation concludes that a significant restriction of the subsistence use of wildlife other than deer is not expected to result from any action alternative of the Shamrock timber sale.

Fish and Shellfish Effects and Evaluation

Fish and shellfish are important subsistence resources used by the rural residents utilizing the analysis area. The Tongass Resource Use Cooperative Survey (TRUCS, 1988) indicated fish and shellfish made up 62 to 81 percent of the household harvest of resources harvested by subsistence users in the analysis area. Average household harvest of salmon, other finfish, and shell fish ranged from 278 to 422 pounds for these communities. Because subsistence users harvest deer and other resources from several islands, these totals do not necessarily reflect specific harvests from the Shamrock area.

Abundance and Distribution of Salmon

Salmon are a major source of subsistence food harvested by the rural residents. Average household harvest of salmon ranged between 85 and 164 pounds for the communities using the study area. These harvest figures do not necessarily reflect specific numbers from the study area.

People who testified at Kake, Petersburg, Point Baker, and Wrangell ANILCA 810 hearings for both the Shamrock EIS and the North and East Kuiu EIS emphasized the importance of protecting salmon habitat. Through use of buffers as directed by the Tongass Timber Reform Act (1990), and the application of BMPs described in the Aquatic Habitat Management Handbook (USDA Forest Service, 1986), the reason for this concern has been significantly reduced or eliminated.

Chapter 4 of this FEIS states that each of the action alternatives has minimal associated risk for significantly impacting fish populations within the study area. The use of stream buffers and the application of Best Management Practices are expected to be effective in protecting fish habitat from the potential effects of the proposed action. All proposed timber harvest units near salmon spawning and rearing streams are protected by buffers of at least 100 feet on each side of Class I streams, and 100 feet on each side of Class II streams that flow directly into Class I streams. The effects from the proposed actions for the foreseeable future are projected to be minor. Thus, the effect on the abundance and distribution of the salmon harvest for subsistence uses within the study area would be negligible.

Abundance and Distribution of Other Finfish

The action alternatives for the study area are projected to have no impact and no foreseeable future impact on other finfish habitat. Therefore, the abundance and distribution of those other finfish would not be affected by the proposed activity.

Abundance and Distribution of Shellfish

Chapter 4 of this FEIS projects no measurable effects due to any action alternatives on habitat for crabs, clams, and other shellfish. The effect on the abundance and distribution of local crabs, clams, and other shellfish is

Access to Fish and Shellfish

Because timber will be harvested on uplands and away from shorelines, access to historic fish and shellfish areas is not projected to be affected by any of the proposed activities. Nor is there a significant possibility that shoreline access will be affected in the foreseeable future because of the Shamrock timber sale. This determination is made because traditional boat access to the area would remain unchanged, although there would be increased access via roading to reaches of streams that were not previously used for the harvest of salmon.

Competition for Fish and Shellfish

The DEIS assumes some residents of the potential logging company have met residency requirements and qualify as subsistence users. However, this is not expected to be substantial, due to the small number of people involved, and the intermittent use of the available subsistence resources.

Fish and Shellfish Findings

Based on the data and models used, this FEIS concludes that the actions proposed in Alternatives 2 through 5 would not cause a significant restriction of subsistence use of fish and shellfish in the analysis area.

Other Foods Effects and Evaluation

Information and data from the Tongass Resource Use Cooperative Survey (TRUCS, 1988), ADF&G Subsistence Division Technical Reports, public comments, and previous ANILCA 810 Subsistence Hearing testimony have provided additional information concerning the gathering of other foods by rural communities using the analysis area. Other foods used for subsistence include plants such as kelp, goose tongue, a variety of berries, etc. Though other foods did not constitute a major

portion of the 1987 subsistence harvest by the rural communities documented in TRUCS, they are considered subsistence resources. TRUCS data indicate that plants make up 1.9 to 7.2 percent of the per capita harvest of principle subsistence resources harvested by subsistence users of the analysis area. The pounds per household ranged from 9 in Wrangell to 38 in Kake.

Abundance and Distribution of Other Foods

Most traditional gathering of other foods occurs near beach and estuarine areas. No activities proposed in the alternatives would infringe upon the beach and estuarine areas. The proposed timber harvest activity would improve the availability of berries in the short-term. Based on a projected increase of berries and the locations of the potential activities, short term and reasonably foreseeable effects of the proposed action alternative on abundance and distribution would be minimal.

Access to Other Foods

Access to traditional other food gathering sites and areas have not been affected by past land use activities and will not be affected by any of the proposals in this analysis. Nor will there be a significant restriction in the foreseeable future as a result of the activities proposed here. This is because traditional means of access via foot, vehicle, and boat would remain the same.

Roads in the study area currently do not exist. Once they are constructed they will provide access to areas not traditionally used for other food gathering. The Forest Service is not aware of any residents from the surrounding rural areas (other than Kake) who would use the current road system to access other food gathering sites and areas.

Competition for Other Foods

People who testified at an earlier Point Baker hearing (USDA Forest Service, 1993a) expressed concern that increased competition from loggers for other foods would affect their ability to harvest those subsistence resources. Point Baker and Port Protection testimony focused on coastal and estuarine areas which provide needed resources for their consumption and use.

Some non-resident employees of the logging operations out of Kake may have actually met residency requirements and qualify as subsistence users.

As indicated in the discussion concerning competition for wildlife, there may be some increased competition for other food resources from Alaska nonresidents and non-rural residents employed at the Kake logging camp. However, this potential increase would not be substantial or long-lived, due to the limited number of people involved and intermittent seasonal access available to the study area.

Other Foods Finding

Based on the data and models used, this FEIS concludes the actions proposed in Alternatives 2 through 5 would not result in a significant restriction of subsistence use of other food resources within the analysis area.

Marine Mammals Effects and Evaluation

The Marine Mammal Protection Act (1972) prohibits the taking of marine mammals by anyone other than Alaska Natives. The Act allows Alaska Natives to take marine mammals, so long as it is used for a "subsistence purpose," or to create "authentic native" handicrafts or clothing and "is not accomplished in a wasteful manner."

The most likely area for any project affects on marine mammals is at the existing log transfer facility (LTF) at Little Hamilton Island. However, there is little likelihood that those impacts will be significant (USDA Forest Service, 1993b). Duncan Canal is a documented area for seal hunting by Native households in Wrangell (Cohen, 1989). Keku Strait and Rocky Pass are used for opportunistic seal hunting by Kake households, usually as an adjunct to deer hunting (Firman and Bosworth, 1990). Currently, there is no evidence to suggest that timber harvest and related development activities have any impact on marine mammals. Therefore, no significant restriction to the subsistence use of marine mammals is expected under any alternative for the Shamrock timber sale.

Timber Effects and Evaluation

The Forest Service free-use policies in Alaska for firewood and timber remain unchanged. None of the proposed alternatives for the analysis area would substantially limit the availability of firewood and personal use timber.

Direct, Indirect, and Cumulative Effects

This DEIS evaluates whether the project, in combination with other past, present, and reasonably foreseeable future actions, may significantly restrict subsistence uses. The precise location of future projects is not clearly known until such time as a project is proposed. The subsistence evaluation concludes whether future activities may significantly restrict subsistence uses.

Action on other lands surrounding the analysis area may also affect subsistence resources harvested by the rural communities utilizing the area. An example is the Kake Village Corporation development of the timber resources on their lands. There is the potential for such development to have long term implications for subsistence users and rural communities utilizing the area.

The wildlife section of this chapter indicates that the habitat capability of black bear, marten, river otter, and deer will be minimally affected as a result of the Shamrock timber harvest. Nor are habitat changes resulting from timber harvest expected to affect distribution of these species on Kupreanof Island.

The cumulative effects on fish habitat are primarily associated with past logging. It is anticipated that application of BMPs and streamside buffers will minimize impacts to fish habitat. The watershed section of this chapter discusses the threshold levels of concern for the watersheds in the project area which indirectly affect fish habitat.

Table 4-21 lists the other timber sale projects proposed in the vicinity of the Shamrock study area. Not enough is known about foreseeable activities on other lands surrounding the project area to predict that subsistence use of deer will not be significantly restricted. However, subsistence use of black bear, furbearers, waterfowl, salmon, other finfish, and other food subsistence resources in the project area are not expected to be significantly restricted by these future activities.

The Forest Service is in the process of revising the Tongass Land Management Plan (TLMP), or Forest Plan, through the NEPA process. Potential effects to subsistence users are being addressed during the revision. Project-specific environmental analyses will be required prior to harvest of any additional timber beyond the amount proposed in this project. Subsistence use effects will be evaluated in each of those analyses.

The TLMP analysis has determined that all of the alternatives considered in the revision of the Forest Plan, if all permissible projects were fully implemented, have the potential to impact subsistence uses of deer, brown bear, and furbearers, specifically marten, due to potential effects of projects on abundance/distribution and competition (TLMP Revision, Supplement to the DEIS). Due to the uncertainties associated with projecting impacts of proposed forest-wide projects fifty years into the future, it is difficult to say whether these impacts would rise to the level that may significantly restrict subsistence uses of these resources.

Should subsistence resources become limited at some point, the Federal Subsistence Board has the authority to regulate subsistence and non-subsistence uses of these resources. This type of action, as prescribed by ANILCA Section 804, may be necessary to ensure the availability of adequate subsistence resources needed by the rural communities using Kupreanof Island.

Displacement of Subsistence Users

Kake Tribal and Sealaska Corporations continue to harvest timber on Kupreanof Island surrounding the community of Kake. This harvest has had a major influence on locally available subsistence resources for the community. Based on public comments and testimony during ANILCA 810 Hearings there is concern about cumulative effects of timber harvest on Kupreanof and Island and elsewhere, and long term implications for resources that communities depend upon for subsistence. As a result of deer harvest closures in the 1970s, Kake subsistence users were displaced to southern Admiralty Island. Because deer populations are now on the increase, subsistence harvest was allowed in the 1993-94 season on Kuiu and Kupreanof Islands.

The proposed timber harvest activities are not expected to displace subsistence users from their traditional areas used for harvesting wildlife, marine mammals, and timber. However, some subsistence users have indicated they would avoid areas when there was noise or other evidence of logging activity in the vicinity. This could result in some temporary displacement of subsistence activities. Since the beach, estuary, and stream buffers where most of the subsistence activities occur will remain intact, subsistence activities will likely resume once the adjacent logging is finished. Additionally, several local residents indicated during subsistence testimony that they would welcome the opportunity to hunt the Kupreanof Island interior afforded by road construction associated with the Shamrock timber sale.

Subsistence Determinations

Section 810 (a)(3) of ANILCA requires that when a use, occupancy, or disposition of public lands would significantly restrict subsistence uses, determinations also must be made that (1) the significant restriction of subsistence uses is necessary and consistent with sound management of public lands, (2) the proposed activity involves the minimum amount of public lands necessary, and (3) reasonable steps will be taken to minimize adverse impacts on subsistence uses and subsistence resources resulting from the action. The proposed action may significantly restrict subsistence uses of deer.

Necessary, Consistent with Sound Management of Public Land

The actions proposed in this document have been examined to determine whether they are necessary and consistent with the sound management of public lands. Standards used for the review include (1) the National Forest Management Act of 1976 and its implementing regulations; (2) the Alaska National Interest Lands Conservation Act (1980); (3) the Alaska Regional Guide (1983); (4) the Tongass Land Management Plan and Draft Revision; (5) the Tongass Timber Reform Act (1990); (6) the Alaska State Forest Practices Act; (7) the Alaska Coastal Management Program; (8) Multiple Use Sustained Yield Act (1960); (9) Subsistence Management and Use Handbook (1985), and (10) Subsistence Evaluation and Finding, FSH 2609.25 (revision 1988).

The ANILCA placed an emphasis on the maintenance of subsistence resources and lifestyles. However, the Act also required the Forest Service to make available for harvest 4.5 billion board feet of timber per decade from the Tongass National Forest and left the Alaska Pulp Corporation (APC) contract in place. The TTRA removed the 4.5 billion board foot requirement from ANILCA, but directed the Forest Service to seek to meet market demand for timber and left the volume requirements of the APC contract in place. In September 1993, APC closed its Sitka Mill. In April 1994 the USDA Forest Service cancelled the APC contract. However, the Shamrock sale is an independent timber sale and was at no time intended to fulfill requirements of the APC contract.

All of the action alternatives involve some potential impact to subsistence uses. Based on the analysis of the information presented in this document on the proposed alternatives, and on the guidance provided by the documents listed above, these actions are considered necessary and consistent with sound management of public lands.

Amount of Land Necessary to Accomplish the Purpose of the Proposed Action

Much of the Tongass National Forest is used by one or more rural communities for subsistence purposes for deer hunting. The areas of most subsistence use are the areas adjacent to existing road systems, the beaches, and the areas in close proximity to communities. Within the project areas, the extent and location of the subsistence use area prevents complete avoidance. Areas other than subsistence use areas that could be harvested may be limited by other resource concerns such as soil and water protection, high-value wildlife habitat, economics, visuals, or unit and road design. Effort was taken to protect the highest value subsistence areas. For example, beach fringe is one of the highest use subsistence areas and will not be affected under any of the proposed alternatives. Only Harvest Unit 55 coincides with documented subsistence deer hunting areas.

The impact of viable timber harvest projects always includes alteration of old-growth habitat which reduces habitat capability for old-growth dependent species. It is not possible to lessen harvest in one area and concentrate it in another without impacting one or more rural communities' important subsistence use areas. In addition, harvestable populations of game species could not be maintained in a natural distribution across the forest if harvest were concentrated in specific areas. A well-distributed population of species is also required by the Forest Service regulations implementing the National Forest Management Act (NFMA).

Reasonable Steps to Minimize Adverse Impacts Upon Subsistence Uses and Resources

Chapter 2 describes the standards, guidelines and mitigation measures that will be implemented as part of the selected alternative. Most of the standards, guidelines and mitigation measures are designed to maintain fish and wildlife habitat productivity at as high a level as possible, while still maintaining a supply of timber.

All of the action alternatives have incorporated the Forest Plan Revision standards and guidelines. Project design criteria included locating roads and units outside of important subsistence use areas such as the beach fringe, estuary fringe, and riparian areas adjacent to salmon streams. This has resulted in protection of the highest value subsistence use areas. For example, beach fringe is one of the highest subsistence use areas, and it will not be impacted under any of the action alternatives.

A significant restriction on the subsistence use of deer in WAA 5133 is expected due to high projected hunter demand in that area. Vegetation and habitat changes associated with the Shamrock timber sale are not expected to significantly affect deer numbers in this WAA, but the improved access provided by logging roads could exacerbate the effects of hunter demand. Closing roads 45803 and 45804, as well as other roads, after harvesting would be likely to reduce hunter demand in WAA 5133.

One of the most significant subsistence resources in the analysis area is salmon. Fish habitat is protected in each alternative through the application of the BMPs and stream buffers. In addition to protecting fish habitat these buffers also protect estuarine and riparian habitat important to other species such as deer, black bear, and furbearers.

FEIS Conclusions

This FEIS for the Shamrock study area reaches a preliminary determination that some significant restrictions on subsistence use may result from the implementation of the preferred alternative. Below is a summary of the evaluation and findings:

> The potential foreseeable effects from the action alternatives in this project do not present a significant restriction of subsistence uses of black bear, furbearers, marine mammals, waterfowl, salmon, other finfish, and other foods. The potential foreseeable effects from the action alternatives in this project may present a significant restriction of subsistence use of deer.
>
> A significant restriction already exists in WAA 5133 due to high demand for deer from Petersburg and other communities. Vegetation and habitat changes resulting from the Shamrock timber sale are not expected to have substantial impacts on the abundance of deer, but will further restrict subsistence use of deer in this WAA. Harvest activities and habitat changes are not expected to result in a significant restriction for subsistence use of deer in WAA 5130.
>
> A significant restriction for subsistence use of deer may result in both WAA 5130 and WAA 5133 due to increased access and competition, regardless of which action alternative is chosen.

The restrictions to subsistence resources that may ensue as a result of the Shamrock timber sale, and the probable causes of those restrictions, are summarized in Table 4-31.

Table 4-31
Summary of Restrictions on Subsistence Resources

Resource	Abundance and Distribution	Access	Competition
Deer	yes	no	yes
Wildlife Other than Deer	no	no	no
Fish	no	no	no
Shellfish	no	no	no
Other Foods	no	no	no

Cultural Resources

Impacts to cultural resources on the Tongass National Forest may result from natural forces, improved public access, or from project-related activities. Weathering and natural erosion are environmental effects which may deteriorate surface structures or features, or alter the sedimentary context of buried cultural material. Timber sale activities can accelerate local erosion with adverse impacts to cultural resources. Improved public access to previously remote areas increases the potential for inadvertent damage to sites, intentional relic collecting, or vandalism. Adverse effects of major ground-disturbing projects on cultural resources can include both primary (direct) and secondary (indirect) impacts, and can contribute to long-term cumulative impact to these resources.

No previously documented or reported sites were known to exist within the Shamrock area prior to the initiation of cultural resource inventory in 1992, and no sites were identified as a result of two field surveys conducted for the Shamrock EIS. However, it remains a possibility that undiscovered sites may be present within areas directly or indirectly impacted by timber harvest activities. Tongass National Forest land use designations with the highest potential for major environmental modifications are those that provide for timber harvest and mineral exploitation (USDA Forest Service, 1991d). While it is impossible to predict specific impacts since it is not certain that any prehistoric or historic sites are present in the study area, potential impacts from timber sale activities on fragile and non-renewable cultural resources, and the range of mitigative measures available can be foreseen.

A number of federal laws address the protection of cultural resources from adverse impacts associated with federally funded or licensed projects. These laws include the National Historic Preservation Act of 1966, as amended; the Archaeological Resources Protection Act of 1979, as amended; and the National Environmental Policy Act of 1969. They require a process for considering impacts on cultural resources as specified in Section 106 of the National Historic Preservation Act and outlined in 36 CFR 800. This process consists of identifying cultural resources, determining significance and eligibility to the National Register of Historic Places, evaluating the effects of undertakings on significant sites, and developing and implementing measures to mitigate any adverse effects. Consultation with the Alaska State Historic Preservation Officer (SHPO) and, in some instances, with the Advisory Council on Historic Preservation are an integral part of the Section 106 process.

Shamrock Predictive Model

Currently the USDA Forest Service probability model for cultural resources in the Tongass National Forest identifies high, medium, and low sensitivity zones based primarily on elevation and slope criteria (Table 4-32). Normally areas of high and medium potential require field survey to identify significant sites prior to project implementation (USDA Forest Service, 1989a). In her cultural overview of Kupreanof Island, Rabich Campbell (1987) emphasized elevation above sea level as the most important criterion for predicting sites. She recommends that the high potential zone encompass all elevations from sea level to 75 ft msl (mean sea level), the medium potential zone include elevations between 75 and 125 ft msl, and the low potential zone to be all areas above 125 ft. Because little systematic cultural resource inventory has been conducted inland from the coast on Kupreanof Island, the predictive model developed for the Shamrock area used a conservative approach to delineate sensitivity zones for initial model development and testing, and surveyed selected sites from all three zones.

Table 4-32
Cultural Resources Sensitivity Zones

Zone	Tongass National Forest[1]	Rabich Campbell[2]	Shamrock EIS
High	Sea level to 100 ft msl	Sea level to 75 ft msl	Sea level to 100 ft msl
Medium	100 to 1,000 ft msl; slope angle < 30%	75 to 125 ft msl	100 to 500 ft msl; slope angle < 30%
Low	100 to 1,000 ft with slope angle > 30%; all elevations greater than 1,000 ft msl; muskeg areas	All elevations above 125 ft msl	500 to 1,000 ft msl with slope angle > 30%; all muskeg areas
Extremely Low	NA	NA	All elevations greater than 1,000 ft msl

[1] USDA Forest Service, 1989a.
[2] Rabich Campbell, 1987.

The research design and cultural resource probability model developed for the Shamrock EIS used a model based on specific topographic landforms associated with documented site occurrence in interior Alaska (Thorson et al., n.d.), combined with the Tongass National Forest sensitivity zone concept. Initially, 210 locations considered by the model to have site potential were identified in the Shamrock area using landform criteria. These locations were then ranked high, medium, and low based on geomorphology, overlook characteristics, resource accessibility, and proximity to each other; they were then divided into three groups according to sensitivity zones. A random sample of five locations with the highest site potential (Rank 3) was selected from each sensitivity zone and a 20 acre survey area was systematically surveyed at each location (300 acres total). No prehistoric or historic sites were identified in this 300 acre survey, although bark-stripped culturally modified trees (not normally considered sites unless other cultural resources are present) were identified at three locations along the coast of Duncan Canal.

Results of an extensive literature search and the initial field survey were used to revise the cultural resource sensitivity zones for the Shamrock area and to develop an inventory plan for a follow-up clearance survey of areas expected to be impacted by timber harvest activities (Betts, 1992). An analysis of site distribution on the Tongass National Forest (USDA Forest Service, 1992b) clearly indicate that the potential for cultural resources above 100 ft msl is extremely low throughout Southeast Alaska. On Kupreanof Island the highest elevation at which cultural resources have been documented is at Irish Creek on the west coast, where a prehistoric site was located approximately 50 ft above the modern shoreline. Culturally modified hemlock were identified and documented up to an elevation of 59 ft msl on the Duncan Canal coast during the initial Shamrock cultural resource survey but were not recorded as sites.

For the Shamrock clearance survey, the elevation break between high and moderate cultural resource sensitivity zones was retained at 100 ft msl (Table 4-32), although no timber harvest units or roads have been proposed within the Shamrock EIS study area below 200 ft msl. For purposes of the Shamrock EIS, the moderate sensitivity zone was considered to be between 100 ft and 500 ft msl where slope angles were less than 30 percent. This modification took into consideration the potential for raised marine terraces which may be present up to an elevation of approximately 200 ft (Rabich Campbell, 1987:4) and the presence of several Alaska-cedar at an elevation of approximately 475 ft msl which were initially thought to be culturally modified (but were later determined to be naturally scarred). Lack of historical documentation for mining activity in the Shamrock EIS study area and negative results from systematic survey at higher elevations resulted in defining elevations between 500 ft and 1,000 ft msl as having low cultural resource sensitivity and all elevations greater than 1,000 ft msl having extremely low sensitivity. In the Shamrock model, all elevations above 500 ft msl with slope angle greater than 30 percent have low or extremely low site potential.

The archeologist surveyed more timber harvest units than initially required by the Shamrock Inventory Plan. Areas of direct and indirect impact below 500 ft msl with a slope angle of less than 30 percent were targeted for clearance survey. The clearance survey also included previously identified high and moderate potential locations below 500 ft msl within 328 ft of proposed ground disturbance or lake margins. Areas for which a complete clearance survey were conducted included elevations below 500 ft msl in 20 timber harvest units, where all identified landings and spur roads were inventoried (Table 4-32). In addition, 20.2 miles of primary and secondary roads below 500 ft msl were surveyed. No surface or subsurface cultural resources were identified in areas of proposed activity during the clearance survey, no sites are anticipated as all probabilities are low, and this finding has been accepted by the SHPO.

Primary Ground Disturbance Impacts

Development of temporary and permanent maintenance and log storage facilities, as well as timber harvest and road construction, have the potential to directly effect cultural resources through ground disturbance. Direct effects on cultural resources associated with timber sales can include alteration to the site setting, destruction or disturbance to surface structures or features, and destruction or displacement of subsurface cultural features or deposits as a result of road construction, rockpits, landings, and yarding activities. Primary impacts are short-term in the sense that they occur during initial ground disturbance, but because cultural resources are non-renewable and the surface and subsurface context of artifacts is critical to the information they can provide, primary impacts have long-term consequences in the sense that the resource or information is lost forever. Impact differences among the alternatives are based on the number of acres below 500 feet that would be harvested

(Table 4-33) and the amount of ground disturbance anticipated (Tables 4-1 and 4-3). According to this analysis, Alternative 2 would have the greatest potential to impact undiscovered sites, Alternatives 4 and 5 would have less potential than Alternative 2, and Alternative 3 would have the least potential of all action alternates. Because of the low potential for cultural resource sites occurring in harvested or roaded areas, however, none of the alternatives, is likely to impact any sites.

No timber harvest or road construction is proposed within areas of high cultural resource sensitivity below 100 ft msl. Failure of the archeological field survey to identify cultural resources in the Shamrock area, lack of documented or reported archeological sites above 50 ft elevation on Kupreanof Island, and the scarcity of cultural resources elsewhere in Southeast Alaska above 100 ft msl suggest there is little potential for timber harvest activities to directly impact undiscovered cultural resources in the Shamrock study area.

Table 4-33
Timber Harvest Units Which Include Acreage Below 500 ft Elevation by Action Alternative

			Approximate Acres below 500 ft			
Harvest Unit	Total Acres	Est. Percent Below 500 ft	Alt 2	Alt 3	Alt 4	Alt 5
10	61	70%	42.7	42.7	42.7	42.7
11	32	10%	3.2	3.2	3.2	
13	102	20%	20.4	20.4	20.4	20.4
15	57	5%	2.9			2.9
20	48	100%	48.0			
(20M)[1]	(27)	100%		27.0	27.0	27.0
24	50	30%	15.0			
25	88	20%	17.6	17.6	17.6	17.6
28	177	70%	123.9	123.9	123.9	
32	156	5%	7.8			
40	43	100%	43.0		43.0	43.0
42	70	70%	49.0	49.0	49.0	49.0
43	21	100%	21.0	21.0	21.0	21.0
46	43	60%	25.8	25.8	25.8	25.8
47	11	80%	8.8	8.8	8.8	8.8
51	54	40%	21.6			
(51M)[1]	(43)	40%			16.8	16.8
52	41	5%	2.1		2.1	
55	63	30%	18.9			
81	68	50%	34.0			
82	27	40%				10.8
83	44	100%			44.0	
Total Acres:	**1,256**		**505.7**	**215.5**	**401.3**	**453.7**

[1] Units 20M and 51M are modifications of Units 20 and 51, respectively. These acres are already included within those of the unmodified units.

Secondary Impacts

For cultural resources, secondary impacts generally relate to increased public access to previously remote areas as a result of the construction of new roads. Improved accessibility to sites can result in a greater amount of inadvertent damage to sites through trampling and displacement of surface artifacts, an increase in unauthorized artifact collecting and illicit excavation, or a surge in vandalism which may result in defacement or theft of cultural resources. These secondary effects are often long-term effects that may escalate as public use of an area increases.

Secondary effects to cultural resources are not expected to result from timber harvest activities associated with the Shamrock EIS. Increased public access to the Duncan Canal coast, where the highest cultural resource potential exists, is not expected to result from road construction since access to the Shamrock area would be from the north where an existing road would be extended southward. No timber harvest units or new roads are proposed within four miles of the Duncan Canal coast. Increased recreational use of the Irish Lakes area and possibly other lakes within the Shamrock area can be expected with improved road access, but no cultural resources were identified along the margins of the two largest lakes where increased public use could be expected. Access to the closest known sites to the Shamrock EIS study area would not be increased by proposed timber sale activities associated with the Shamrock EIS.

Maintenance and Log Storage Yards

Cultural resource field investigations for the Shamrock EIS did not take into consideration potential impacts from log transfer facilities or maintenance and storage yard locations within the analysis area, which were identified after field surveys were completed. All four proposed log storage areas are situated on large flats with side slopes from level to 5 percent and are located on small muskeg openings or covered with non-merchantable scrub timber stands. The two locations within the Shamrock area (sites C and D) are below 500 ft in elevation with non-muskeg areas having moderate site potential according to the Shamrock predictive model. Once a final decision on whether one or more of these proposed log storage facilities would be developed, archeological clearance should be undertaken prior to actual ground disturbance.

Cumulative Effects

Combined impacts to cultural resources on the Tongass National Forest from natural weathering and erosion, public use, and timber harvest have resulted in past disturbance to cultural resources. Development projects such as boat harbors, fish passes, communications facilities, airports, recreation facilities, and road construction pose particular threats to cultural resources since these ground disturbing projects, by their nature, tend to be located where evidence of past historic and prehistoric human activity is likely to be found. Along with these types of development, future timber management activities, combined with natural forces, can result in continued disturbance of cultural resources.

Potential cumulative effects to cultural resources as a result of timber harvest activities associated with the Shamrock EIS may occur from the southward expansion of the road network on Kupreanof Island, which would eventually allow public access to other areas outside the Shamrock area that have known cultural resources or a higher potential for undiscovered sites. However, the number and nature of cultural resources potentially threatened by future development outside the Shamrock area cannot be determined. Past cultural resource inventories indicate that most sites are located in close proximity to present coastlines where present and future harvests are now restricted.

Mitigative Measures and Monitoring

Avoidance and Protection

Mitigative measures for protection of unidentified cultural resources which may potentially exist within the Shamrock area apply similarly to all action alternatives. Whenever possible the preferred mitigative measure would be protection of cultural resources through avoidance of project-related disturbance to the resource. Avoidance is the preferable mitigative option because it provides for the complete protection of a non-renewable resource from direct project related impacts. Avoidance of an impact may require relocation or redesign of timber harvest units or other ground-disturbing activities, realignment of roads, or protection of sites by establishing buffer zones or physical barriers.

As outlined in Title 2300 of the Forest Service Manual (USDA Forest Service, 1989a), each contract, permit, or lease is required to include a statement of the contractor's obligations for the protection of cultural resources, to explicitly notify the contractor of his or her responsibility to protect marked sites, and to inform the contractor as to his or her liability for damage to cultural resources. If a previously undiscovered cultural resource is found during the course of the project, it is the contractor's responsibility to protect all cultural resources against destruction, removal, or damage during the operating period. The project manager is required to halt any work that might potentially damage the site and immediately notify the Forest Service. The Forest Supervisor, in consultation with the SHPO, is required to determine the significance of the site and potential impacts the project may have on it. Work may not resume in the immediate vicinity of the site until SHPO consultation has been completed and the Forest Supervisor authorizes resumption. As a check on the validity of the Shamrock Predictive Model and the effectiveness of the pre-sale cultural resources inventory, areas of ground disturbance, including areas above 500 ft msl considered by the Shamrock predictive model to have low or extremely low potential for cultural resources, should be inspected after road construction or timber harvest by Forest Service or contract archaeologists to determine if deeply buried sites, not apparent during earlier field survey, are present.

Site Evaluation and Data Collection

Should previously unknown cultural resource properties be identified during the course of timber harvest activities, these properties will be evaluated by a professional Cultural Resource Specialist following established procedures and regulations in 36 CFR 63 and 36 CFR 800 to determine the significance of the resource and its eligibility for the National Register of Historic Places, as well as the effect of proposed activities on the property. For those properties eligible or potentially eligible for inclusion in the National Register, site-specific measures will be designed and implemented to mitigate any adverse impact to the resource. Where avoidance is not possible, mitigative measures require recovery of scientific data prior to disturbance of the site. Site recording normally involves site mapping and documentation, and may include subsurface testing or excavation. Recovery of site information through testing and excavation is less desirable as a mitigative option than complete avoidance and protection, since it only partly compensates for adverse impacts to non-renewable resources, and because of the expense involved with testing and excavation of subsurface sites, as well as resulting project delays.

Site Monitoring and Buffer Zones

Mitigation of long-term cumulative effects of forest development and timber harvest can be addressed through implementation of background research and field inventories prior to initiation of ground disturbing projects. Potential adverse impacts to cultural resources can be avoided or mitigated by early identification, protection, and continued monitoring of sites, and by providing data through testing and excavation of those sites where disturbance cannot be avoided. Video documentation of sites is playing an increasingly important role in providing baseline data on sites and in recording changes in site conditions from natural erosion or human activity. Continued enforcement of 1,000-foot estuary, 500-foot beach fringe, and 100-foot stream and lake margin protective buffer zones for future timber sales would effectively decrease the potential for direct impact to most cultural resources.

Confidentiality of Site Data and Public Education

Maintenance of confidentiality regarding site locations, combined with efforts to direct public use away from the most vulnerable sites would help protect cultural resources in areas of increased public use. Periodic monitoring of known cultural resource sites on Kupreanof Island by Forest Service personnel for evidence of natural or human-caused impacts, along with continued public education concerning the fragile and sensitive nature of non-renewable cultural resources and their critical role in furthering our understanding of past human events, would also help mitigate potential cumulative effects on cultural resources resulting from timber harvest activities.

Recreation

The introduction of roads, rockpits, and harvest units into the landscape of the Shamrock area would alter the recreation setting (including attributes such as remoteness and the evidence of human activity) and cause a shift toward the development end of the recreation opportunity spectrum. This shift would bring about increased opportunities associated with roads, and decreased opportunities associated with primitive forms of recreation. Recreational use, particularly at attractive features such as Irish Lakes (an identified Recreation Place) and the upper reaches of the Castle River, would likely increase as a result of increased road access.

Access

With the exception of Alternative 1 (no action), all of the alternatives include road construction. New roads would provide additional public access into the Shamrock area. Such access would facilitate recreational uses, such as sport fishing, sport hunting, hiking, and wildlife viewing, as well as subsistence uses. Roads would also provide opportunities for new uses, such as off-highway vehicle recreation and mountain biking.

Alternative 2 would provide the greatest increase in road mileage. Public access would be provided to the southern boundary of the Shamrock area, the two unnamed lakes (locally referred to as Kluane Lakes) and Irish Lakes, and the northwestern portion of the Castle River drainage. Alternatives 4 and 5 would provide similar increases in public access, but would construct fewer roads in the Castle River area. Alternative 3 would create fewer roads than Alternatives 2, 4, and 5. This alternative would provide road access to the two unnamed lakes and Irish Lakes, and some access to the upper portion of Castle River, but would not provide access to the southern portion of the Shamrock area. Alternative 1 would have no affect on public access. None of the alternatives would provide access to Duncan Canal, Rocky Pass, or Sumner Strait.

Recreation Opportunities

Most of the Shamrock area (90 percent) is characterized by essentially natural, unmodified environments with little evidence of human activity. This recreation setting provides for predominately primitive recreation opportunities and experiences. Changes to this recreation setting would directly affect recreation opportunities and the nature of future recreation experiences in the area. Some opportunities for primitive experiences would be foregone. Other recreation opportunities, particularly those for semi-primitive non-motorized and roaded modified experiences, would be created.

The Recreation Opportunity Spectrum (ROS) provides a framework for evaluating potential impacts to recreation resulting from changes in recreation settings. The Forest Service has established three criteria for delineating ROS classes that are applicable to the Shamrock area: size; remoteness; and evidence of human activity (USDA Forest Service, 1986). Based on an analysis of these factors, the expected change in ROS class can be predicted and potential losses and gains in recreation opportunity evaluated and compared between alternatives. ROS classes (defined in Chapter 3) include primitive, semi-primitive non-motorized, and roaded modified.

Alternatives 2, 4, and 5 would all result in a reduction of primitive ROS class acreage and an increase in the semi-primitive non-motorized and roaded modified ROS acreage in the Shamrock area (Table 4-34). Under Alternatives 2, 4, and 5, the total area of primitive ROS class would be reduced by 60 percent from 82,622 acres (76 percent of the total Shamrock area) to 16,829 acres (16 percent). Acres of semi-primitive ROS class would increase by 38 percent for Alternative 2, and by 44 percent for Alternatives 4 and 5. Acres of roaded modified ROS class would increase by 22 percent for Alternative 2, and 17 percent for Alternatives 4 and 5.

Under Alternative 3, harvest units would be concentrated in the northern portion of the Shamrock area and would affect a smaller portion of the total area resulting in smaller reductions of primitive settings and smaller increases in roaded modified and semi-primitive non-motorized settings. Under Alternative 3 primitive setting opportunities would be reduced by 33 percent, semi-primitive non-motorized

Table 4-34

Changes in Acres of Recreation Opportunity Classes by Alternative[1]

ROS Class	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Primitive I and II	82,622	16,829	46,803	16,829	16,829
Semi-Primitive Non-Motorized	9,468	51,501	33,670	56,833	56,902
Semi-Primitive Motorized	4,299	4,299	4,299	4,299	4,299
Roaded Modified	5,430	29,190	17,047	23,858	23,789
Roaded Natural	535	535	535	535	535
Water	5,817	5,817	5,817	5,817	5,817
Total	**108,171**	**108,171**	**108,171**	**108,171**	**108,171**

[1] Land, lakes, rivers, and marine waters are included in acreages.

opportunities would increase by 22 percent, and roaded modified opportunities would increase by 11 percent (Table 4-34). Recreation opportunity settings would not be affected by Alternative 1.

Wild and Scenic Rivers

Castle River, Irish and Keku Creek, and Tunehean Creek are currently being considered in the Tongass Land Management Plan Revision.for possible inclusion into the National Wild and Scenic Rivers System. The effects of timber harvesting, road construction, and other site activities proposed within the Shamrock study area have potential consequences to the wild and scenic river resource and are described in this section.

In order to adequately analyze how the alternatives effect the wild and scenic river values, the Wild and Scenic River Act of 1968 must be considered. It states that "...selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreation, geologic, fish and wildlife, historic, cultural or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected..." The interim management of eligible rivers require protection of the rivers free-flowing characteristics, outstandingly remarkable values, and the river corridor (one-quarter mile on each side of the river), to a level of their highest potential classification. In addition, for Wild rivers, "special emphasis will be applied to visual quality outside the river corridor."

In selected alternatives, units were limited in size, reduced in number, partially obscured, and green tree retention provided within the unit boundaries to reduce impacts upon visual quality. Scenery, however, is not an outstandingly remarkable value for any of the eligible rivers within the Shamrock study area. The protection may be modified or discontinued for eligible rivers identified in the forest planning process if determined to be unsuitable for the Wild and Scenic Rivers System, following the appropriate review process (FSH 1909.12, 8.4). The description, eligibility, and classification of the wild and scenic study rivers found in the Shamrock study area are described in Chapter 3.

Effects on Wild and Scenic Rivers

All alternatives protect the recommended eligibility and classification of Castle River, Irish and Keku, and Tunehean Creek. No foreseeable effects would preclude their potential recommendation for Wild and Scenic River designation. Each of the outstandingly remarkable features for which these rivers were found to possess are protected. Alternative 2 would require that the units located within the river corridor be deleted, if selected prior to completion of the Forest Plan Revision.

Alternative 1: This is the No Action alternative and maintains the current condition of the project area with no proposed road construction or timber harvest.

Alternative 2: Seven harvest units are proposed within the corridor of eligible wild and scenic rivers. Six harvest units (20, 24, 29, 31, 32, and 81), are located within one-quarter mile of Castle River. One harvest unit (51), is located within one-quarter mile of Tunehean Creek. Although harvesting is currently restricted in the river corridors, final determination of the recommendation or non-recommendation of these rivers for designation depends on the final Forest Plan Revision. Alternative 2 was developed to plan some harvesting in the river corridors in the event they were not recommended for inclusion into the National Wild and Scenic River System. If the Forest Plan Revision is not completed prior to this project, these seven units would have to be deleted from the project if this alternative is selected in order to protect

the eligibility of the study rivers for Wild and Scenic River designation. Portions of Units 15, 23, 25, 29, 31, 32, 33, 36, 37, 48, and 61 would be visible from Castle River. Portions of Units 28 and 51 would be visible from Tunehean Creek, and a portion of Unit 42 would be visible from Irish Lakes.

Alternative 3: No harvest units, roads, or other management activities are proposed within the corridors of eligible wild and scenic rivers. A portion of Unit 42 is visible from Irish Lakes, but predominantly obscured by a foreground ridge along the northwest shore of the lake. The unit is also situated at an oblique angle from view. A small portion of Unit 25 would be visible from Castle River.

Alternative 4: No harvest units, roads, or other management activities are proposed within the corridors of eligible wild and scenic rivers. Portions of Units 25, and 36 would be visible from Castle River. Portions of Units 28, and 51-M would be visible from Tunehean Creek, and a portion of Unit 42 would be visible from Irish Lakes.

Alternative 5: No harvest units, roads, or other management activities are proposed within the corridors of eligible wild and scenic rivers. Portions of Units 15, 23, 25, 36, and 61 would be visible from Castle River. Portions of Units 28, 48, and 51-M would be visible from Tunehean Creek, and a portion of Unit 42 would be visible from Irish Lakes.

Cumulative Effects

The cumulative effects of Shamrock and other timber sales on recreation would be significant reductions in existing roadless areas and the loss of primitive recreation opportunities on most of Kupreanof Island. These opportunities would be replaced with other forms of recreation, including both motorized and non-motorized uses.

Enhancement Opportunities

Timber harvesting in the Shamrock area would result in additional public access and new opportunities for future recreational use of the area. These opportunities could be enhanced through development of recreational facilities in the area. Many of these enhancement opportunities may be possible through funding under the Knutson-Vanderburg (KV) Act of 1930 as amended. Several potential enhancement measures that would capitalize on the presence of attractive natural features (such as lakes and streams) and/or anticipated future road access, are described briefly below. The enhancement measures do not differ by alternative.

Kupreanof Island Map/Guide - Although a map of Kupreanof Island would extend outside the Shamrock area, the need for such a map is directly related to the development of additional roads on the island (most of which will occur as a result of proposed harvesting) and the anticipation of greater recreational interest over time. The map would be a useful guide for the public, directing use to appropriate areas and developed facilities, and could be used to educate the public regarding timber harvesting activities and regulations. The map could also serve to interpret interesting landscape features of the island. Such a map was identified in the Petersburg Ranger District 1991 - 1996 Recreation Plan, which was developed with considerable public input.

Trailhead and Trail to Irish Lakes - Irish Lakes have been identified as a Recreation Place by the Forest Service with the potential for trailhead and trail development. The lakes are also the focal point for a Semi-Primitive (SP) Land Use designation identified in the TLMP Revision. Timber harvesting would create permanent roaded access less than a mile from the lakes creating an excellent opportunity to develop a trailhead and hiking trail to the lakes. A trailhead could be located in Harvest Unit 42 with a parking area established in a rockpit proposed for the site. A boardwalk hiking

Recreational cabin at the mouth of the Castle River, near Shamrock area.

trail could be constructed to and around Irish Lakes. A small day use/overnight area could be constructed along the trail with a picnic table and tent platform/shelter. A boat and small dock could be provided at the larger lake.

Viewpoint, Trailhead and Trail at Other Lakes - The proposed main arterial road would pass just to the west of the two unnamed lakes locally referenced to as Kluane Lakes providing an opportunity for vehicle access within close proximity to the lake shore. A pull-out/viewpoint along the main road, which would also serve as a small parking area/trailhead, could be developed. A boardwalk to the lake shore and around the two lakes could be constructed. Because of its close proximity to the road, the area could be designed to be universally accessible. The trailhead could include interpretive information about the area.

Castle River Trail - To provide longer trail opportunities and create public access to the upper Castle River, a trail could be constructed from the proposed main arterial road near Harvest Unit 83 along the Castle River. The trail could also be extended to connect to the Irish Lakes Trail using the established roadway. Sections of boardwalk and several bridges would be required to complete the trail.

Visual Resources

The evaluation of potential visual impacts for the Shamrock harvest is based on the underlying assumptions that forest visitors prefer to view naturally appearing landscapes, and that natural resources of the Forest must be managed for multiple uses, including timber harvest. The ability of the action alternatives to satisfy these criteria was evaluated based on the following impact categories: degree of modification to the existing visual condition of the Shamrock area; the visibility of management activities from sensitive viewing locations; and the ability of the action

alternatives to meet the inventory visual quality objectives (VQOs) for the area. The degree to which each of the alternatives satisfies these criteria was evaluated and compared to identify a preferred alternative for visual resources.

Effects on Existing Visual Condition

All action alternatives would result in varying degrees of modification to the existing visual condition (EVC) of the Shamrock area. Most of that change (86 to 94 percent, depending on the action alternative) would occur in unmodified or naturally appearing landscapes. The remaining modifications would occur in areas previously affected by timber harvest activities.

Of the 95,674 acres of naturally appearing landscape in the Shamrock area, Alternative 3 would result in the least amount of modification (1 percent), followed by Alternative 4 (1.7 percent), and Alternative 5 (1.8 percent). Alternative 2 would affect the greatest acreage of unmodified landscape, more than twice that (2.6 percent) of Alternative 3. In areas previously affected by landscape modification (6,678 acres of the Shamrock area), all the action alternatives would result in approximately 254 additional acres of modification due to timber harvest activities associated with the North Irish Timber Sale.

Changes in the existing visual condition due to road development would vary by alternative similar to that for harvest units. Among the action alternatives, the majority of new road miles would be located in landscapes that are unmodified or naturally appearing. Alternative 3 would result in the fewest miles of new road (21.5) in unmodified landscape, followed in ascending order by Alternative 5 (30.7 miles), Alternative 4 (31.1 miles), and Alternative 2 with the greatest number of road miles (39.7) located in naturally appearing landscapes. For all the action alternatives, approximately 4 miles of road would be located in areas previously disturbed by management activity. The greatest number of rockpits (24) would be located in areas of unmodified landscape under Alternative 2. Alternative 3 would introduce the fewest number of rockpits (9) into the unmodified landscape, followed by Alternative 4 and 5, with 12, and 16, rockpits respectively.

Seen Areas

The majority of the harvest units, roads, and rockpits proposed under the four action alternatives would not be seen from the visually sensitive saltwater travel routes that surround Kupreanof Island (Table 4-35). Those few harvest units that could be seen would be more than three miles away from the nearest saltwater. The proposed harvest activities under any of the action alternatives would not be seen from the Petersburg-Kake (northern) small plane route. In contrast, many of the units proposed to be located in the southern portion of the Shamrock area would be seen from the Petersburg-Tebenkof Bay (southern) small plane route.

Visual simulations of the action alternatives were produced from two locations near the Petersburg-Tebenkof (southern) small plane route. The simulations were used to compare and evaluate the visual effect of the alternatives. Three dimensional computer modeling was used to accurately locate the harvest units and roads in the terrain. Actual photographs of the area modeled were scanned into a computer and digitally manipulated to portray the appearance of the harvest units and roads.

Figure 4-5 depicts the appearance of the Castle River drainage under all the action alternatives as seen from just north of the southern plane route. Under Alternative 2 in the selected viewpoint, Units 20, 23, and 28 are seen in the middleground distance zone of the plane route. Units 23, 25, 43, 54, and 61 can be seen in the background. Under Alternative 3, Unit 20-M is seen in the middleground, and Units 25, 43, and 54 in the background. Alternative 4 is the same as Alternative 3, except for the addition

Table 4-35

Harvest Unit Acreage Seen from Middleground and Background Distance Zones of Visually Sensitive Locations by Action Alternative[1]

		Middleground		Background	
		No. of Units	Acres	No. of Units	Acres
Alternative 2	Duncan Canal	0	0	4	192
	Sumner Strait	0	0	0	0
	Keku Strait	0	0	0	0
	Petersburg-Kake Plane Rte	0	0	0	0
	Petersburg-Tebenkof Bay Plane Rte	20	1,344	8	490
Alternative 3	Duncan Canal	0	0	0	0
	Sumner Strait	0	0	0	0
	Keku Strait	0	0	0	0
	Petersburg-Kake Plane Rte	0	0	0	0
	Petersburg-Tebenkof Bay Plane Rte	2	32	5	264
Alternative 4	Duncan Canal	0	0	0	0
	Sumner Strait	0	0	0	0
	Keku Strait	0	0	0	0
	Petersburg-Kake Plane Rte	0	0	0	0
	Petersburg-Tebenkof Bay Plane Rte	10	599	5	262
Alternative 5	Duncan Canal	0	0	2	168
	Sumner Strait	0	0	0	0
	Keku Strait	0	0	0	0
	Petersburg-Kake Plane Rte	0	0	0	0
	Petersburg-Tebenkof Bay Plane Rte	14	752	6	415

[1] Harvest unit acreage would not be seen from Foreground Distance Zones of visually sensitive locations.

of Unit 28 which can be seen in the middleground. Under Alternative 5, Units 20-M, 28, 82, and 83 can be seen in the middleground and Units 25, 43, 54, and 61 in the background.

Figure 4-6 depicts the view to the northeast from near the southern small plane route for all the alternatives. Under Alternative 2, Units 51, 48, 35, and 37 would be seen in the middleground distance zone, whereas under Alternative 3 no units would be seen in this view. Alternatives 4 and 5 would result in a similar appearance as Alternative 2 with Units 51-M, 48, 35, and 37 seen in the middleground.

Alternative 2 would have the greatest impact to the visual resources of the Shamrock area. Portions of four units (22, 33, 55, 61) could be seen in the background distance zone from Duncan Canal. From the southern small plane route portions of 20 units (15, 20, 23, 24, 28, 29, 31, 32, 33, 35, 36, 37, 40, 46, 48, 51, 52, 55, 61, 81) would be seen in the middleground distance zone, and portions of 8 units (23, 25, 42, 43, 46, 52,

54, 61) would be viewed in the background distance zone. Timber harvest activities would not be seen from Sumner and Keku straits which are nearly 10 miles away from the proposed harvest areas.

Alternative 3 would have the least visual impact of the action alternatives. Besides harvest activities not being seen from saltwater travel routes and the northern plane route, most of the harvest activities proposed for the southern portion of the Shamrock area under Alternative 2 would not occur under Alternative 3. Therefore, portions of only two units (20-M, 46) would be seen in the middleground distance zone of the southern plane route, and portions of five units (25, 42, 43, 46, 54) would be seen in the background distance zone.

Although Alternatives 4 and 5 would result in similar acreages of disturbance, Alternative 4 would result in fewer impacts to the visual resource. Under Alternative 4, harvest activities would not be seen from the saltwater travel routes and the northern small plane route; for Alternative 5, a portion of two units (22 and 61) would be seen in the background distance zone from Duncan Canal. Under Alternative 4, portions of ten units (20-M, 28, 35, 36, 37, 40, 46, 48, 51-M, 52) would be seen in the middleground distance zone of the southern small plane route, and portions of five units (25, 42, 43, 46, 52) could be seen in the background distance zone. In comparison, under Alternative 5, portions of 14 units (15, 20-M, 23, 28, 35, 36, 37, 40, 46, 48, 51, 61, 82, 83) would be seen in the middleground of the southern plane route, and portions of six units (23, 25, 42, 43, 46, 61) would be seen in the background distance zone.

Two log storage, sorting, and scaling facilities are proposed for the Shamrock harvest, which are to be selected from four potential sites (Sites A-D). Sites C and D are located adjacent to Road 6314 in the central area of Kupreanof Island. Neither facility would be seen from the saltwater boat routes (Duncan Canal, Sumner and Keku straits), or from the northern plane route (Petersburg-Kake). Site D would be seen in the middleground (1/4 to 3 miles) distance zone of the southern plane route (Petersburg-Kake Bay), whereas Site C would not be discernable, and would be in the background distance zone. The two other potential sites (Sites A and B) are located outside of the analysis area.

Inventory Visual Quality Objectives

The Inventory Visual Quality Objectives (VQOs) for the Shamrock area set forth the management goals for visual resources, but do not incorporate other resource values or management direction associated with other forest resources such as soils, timber, or wildlife. VQOs suggest varying degrees of acceptable landscape modification based on landscape variety, viewer sensitivity, and viewing distance. In areas of distinctive landscape character, and high viewer interest, VQOs of retention and partial retention suggest managing for little or no visible change in the landscape. In areas of common or minimal landscape variety that are infrequently seen by forest visitors, the VQOs of modification and maximum modification allow for management activities that dominate the landscape, although they must appear as natural patterns from a distance.

Visual quality objectives (VQOs) within the Shamrock area would be met under all the alternatives. Among the action alternatives, the majority of harvest unit acreage would be located in areas where the inventoried VQO allows for maximum modification (Table 4-36). Most of the remaining harvest unit acreage would be located in areas where the inventoried VQO allows for modification. The remaining harvest unit acreage would be located in areas with an inventoried VQO of partial

A. No Action Alternative

Figure 4-5 Visual simulations of all alternatives looking north into the Castle River drainage. The photopoint is an aerial location (approximately 2000 feet above the ground) taken from just north of the Petersburg-Tebenkof small plane route. The small plane route is located at the southern end of the study area.

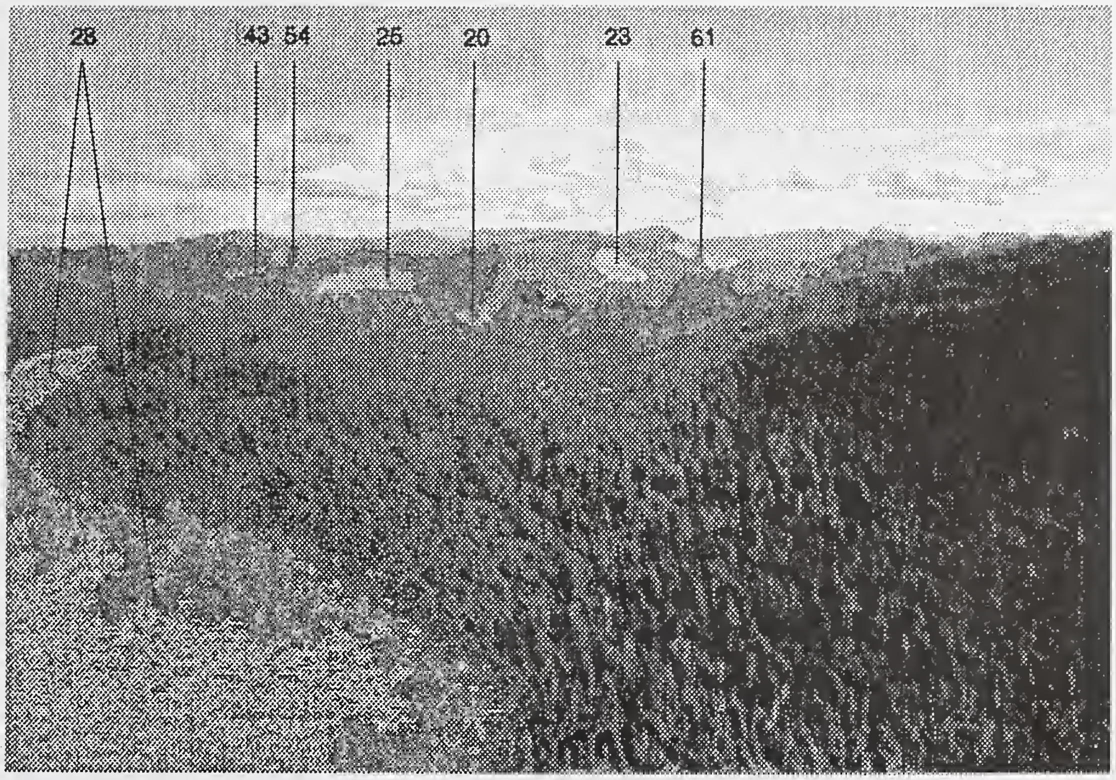
A. **No Action Alternative** - There would be no modifications to the existing visual condition of the landscape.

B. **Alternative 2** - Unit 28 can be seen in the immediate middleground distance zone of the plane route (lower left). Unit 20, and a portion of Unit 23 can be seen in the distant middleground. Portions of Units 61 and 23, and Units 25, 43, and 54 can be seen in the background distance zone of the plant route. Green tree retention in Units 23 and 61 is not depicted.

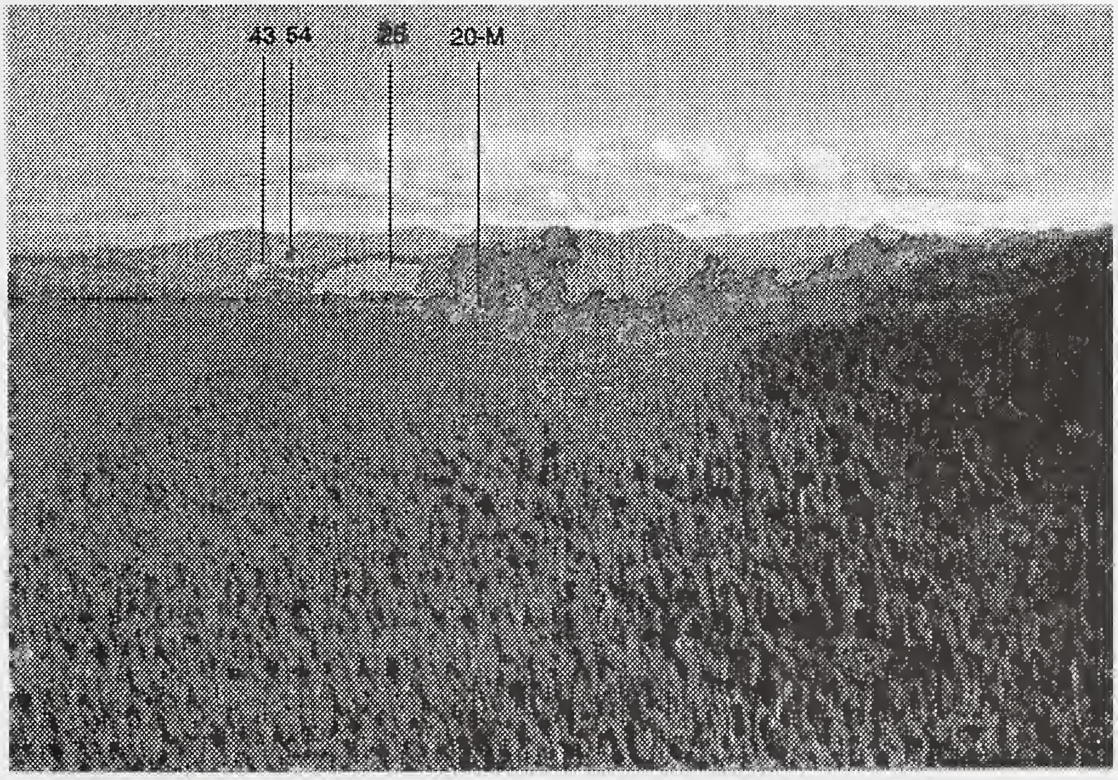
C. **Alternative 3** - Unit 20 can be seen in the middleground distance zone of the plane route, and Units 25, 43, and 54 can be seen in the background distance zone.

D. **Alternative 4** - Unit 28 can be seen in the immediate middleground distance zone (lower left), and Unit 20-M in the distant middleground of the plane route. Units 25, 43, and 54 can be seen in the background distance zone.

E. **Alternative 5** - Unit 28 can be seen in the immediate middleground (lower left) of the plane route, with Units 83, 20-M, and 82 seen in the distant middleground. Units 23, 25, 43, 54, and 61 can be seen in the background distance zone. Green tree retention in Units 23 and 61 is not depicted.

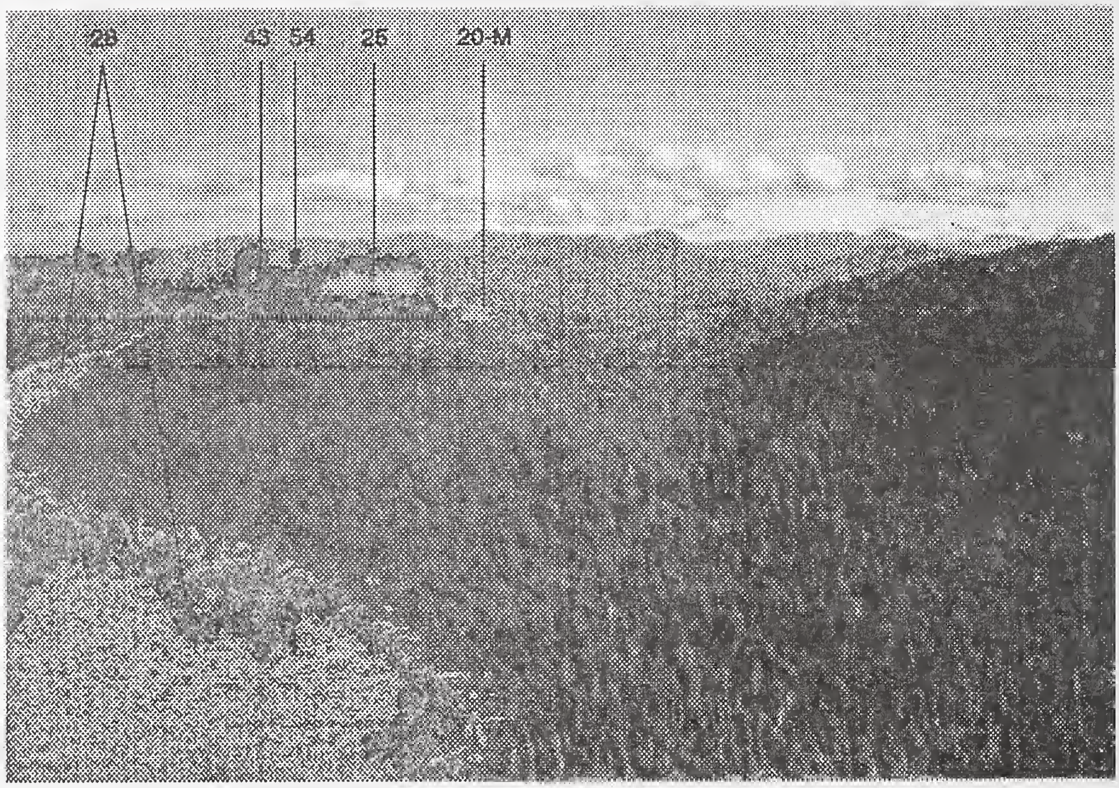


B. Alternative 2

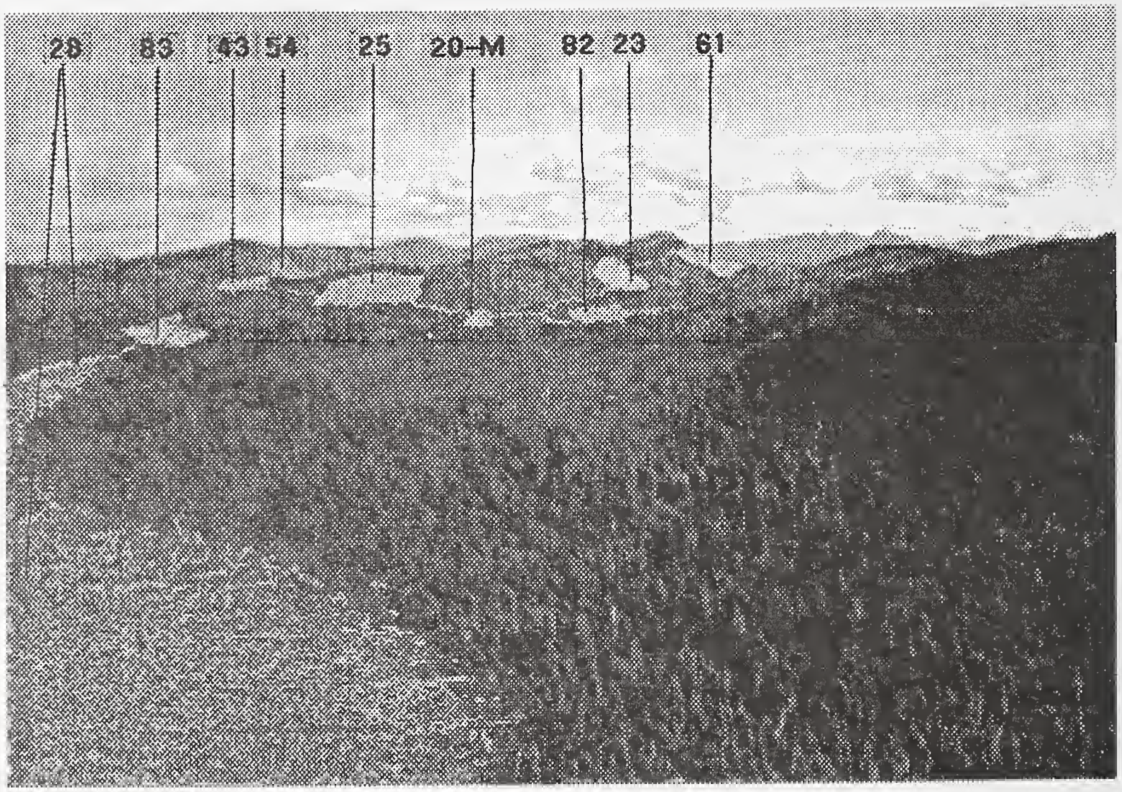


C. Alternative 3

Figure 4-5 (continued). Visual simulations looking north into the Castle River drainage.



D. Alternative 4



E. Alternative 5

Figure 4-5 (continued). Visual simulations looking north into the Castle River drainage.

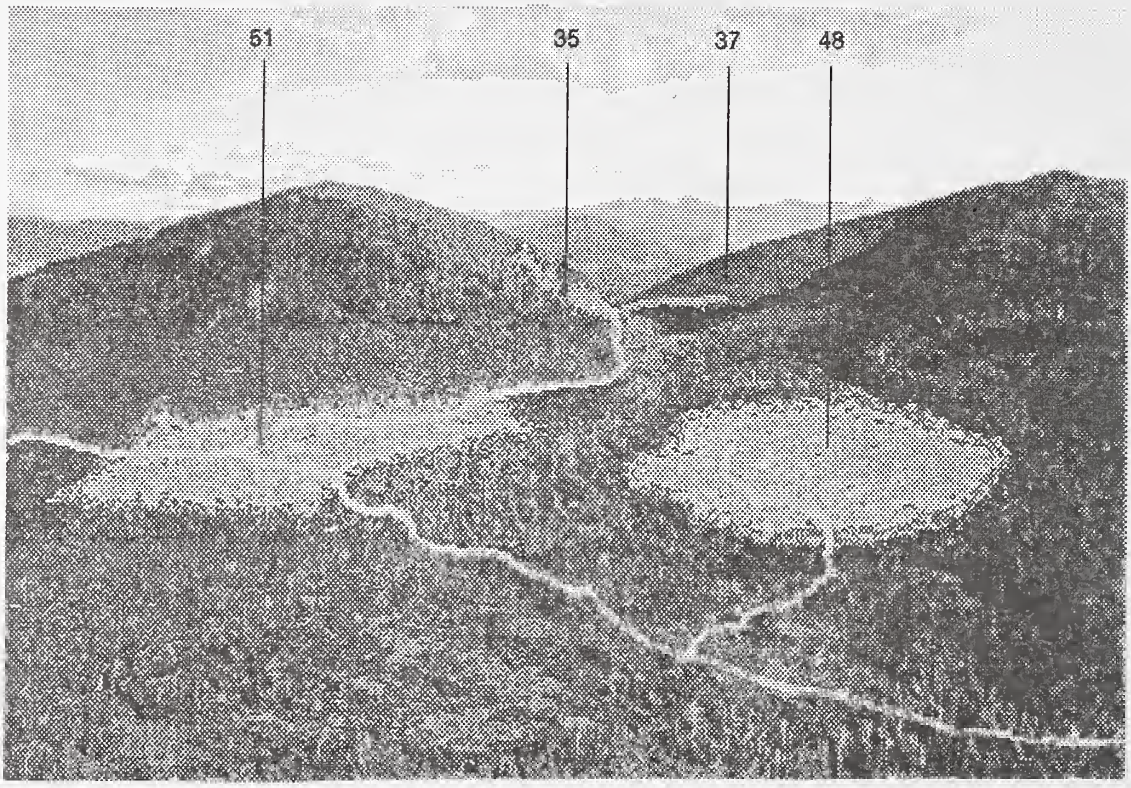
A. No Action Alternative and Alternative 3.

Figure 4-6 Visual simulation of all alternatives looking to the northeast into the Castle River drainage. The photopoint is an aerial location (approximately 2000 feet above the ground) taken from just south of the Petersburg-Tebenkof small plane route. The small plane route is located at the southern end of the study area.

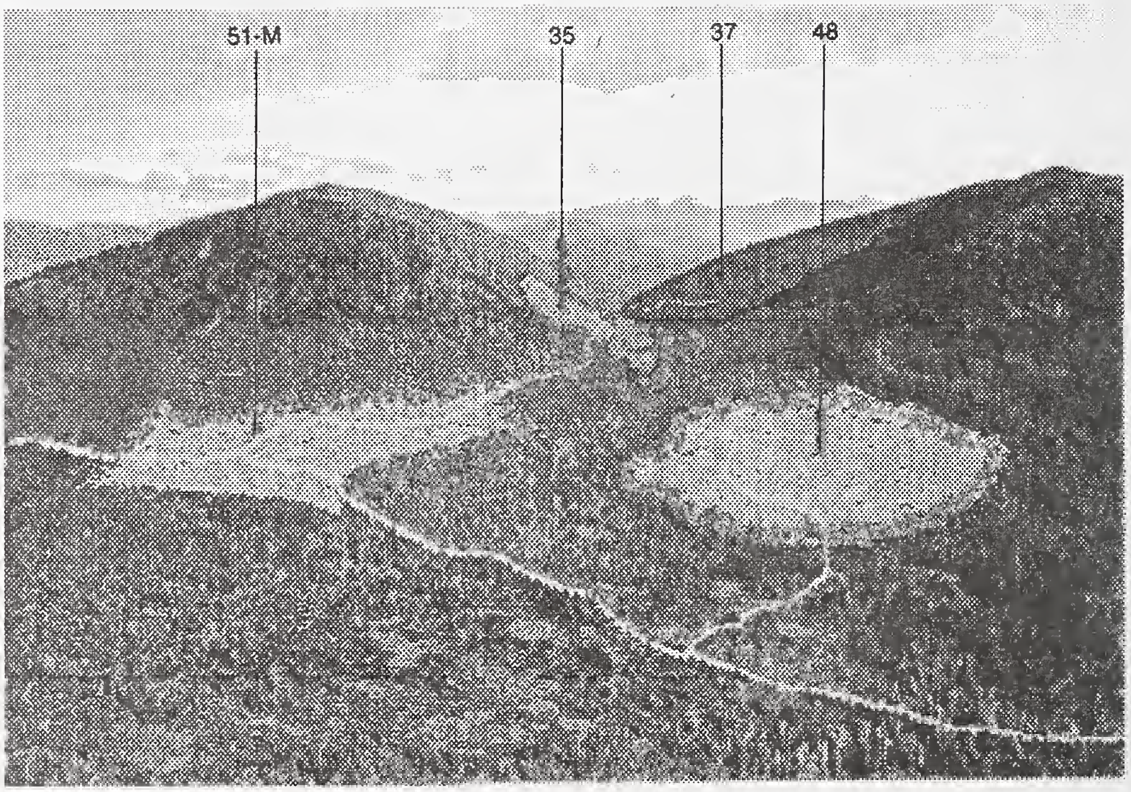
A. **No Action Alternative and Alternative 3** - No units or roads can be seen in this view.

B. **Alternative 2** - Units 51, 48, 35, and 37 can be seen in the middleground distance zone of the small plane route.

C. **Alternatives 4 and 5** - Units 51-M, 48, 35, and 37 can be seen in the middleground distance zone of the plane route.



B. Alternative 2



C. Alternatives 4 and 5

Figure 4-6 (continued). Visual simulations looking northeast into the Castle River drainage.

Table 4-36
Harvest Unit Acreages in VQO Categories for the Action Alternatives

VQO	Total Area	Acres Modified Alt 2	Alt 3	Alt 4	Alt 5
Retention	184	0	0	0	0
Partial Retention	6,344	121	16	72	72
Modification	12,463	936	184	422	518
Maximum Modification	83,421	1,562	883	1,179	1,265

retention. Like the harvest units, the vast majority of road miles and rockpits would be in the maximum modification VQO setting for the action alternatives. Most of the remaining road miles and rockpits would be in a modification or partial retention VQO setting.

None of the alternatives would result in changes to the 184 acres of retention VQO within the Shamrock area. Among the action alternatives, Alternative 2 would result in changes to the greatest number of acres of partial retention, modification, and maximum modification VQOs, followed by Alternative 5, 4, and 3 in descending order. Alternative 2 would affect nearly twice as many acres of partial retention VQO than Alternatives 4 and 5, and more than seven times that of Alternative 3. Under Alternative 2, there would be a similar number of harvest acres in areas of modification as in areas of maximum modification; under Alternatives 3, 4, and 5, however, the majority of timber harvest acres would be located in areas of maximum modification.

Construction and operation of a log storage, sorting, and scaling facility at either the Site C or D location would meet the visual quality objectives (VQO) for the area. Both site locations have a VQO of maximum modification which allows for management activities that dominate the characteristic landscape, as long as such occurrences appear natural when viewed as background (over 3 miles) and reduction of visual contrasts occur within 5 years of facility use. Both site locations would be in compliance with the LUDs from the 1979 Forest Plan, and the Forest Plan Revision, both of which allow for intensive development of resources in these areas.

Visual Management Classes

Visual Management Classes (VMCs) are a visual resource management tool used in project planning to indicate the relative ease or difficulty of meeting the VQOs for an area. VMCs temper VQOs by considering other landscape factors such as slope and slope aspect in addition to landscape variety, viewer sensitivity, and distance zone. Of the four visual management classes, VMC 1 and 2 are the more restrictive and indicate special consideration may be necessary in project planning to meet VQOs. VMCs 3 and 4 are less restrictive and typically indicate management objectives should be met without special consideration in most areas. For timber harvesting, treatment in areas of special consideration could include partial cutting techniques such as green tree retention or group selection as well as greater landscape architectural input in the interdisciplinary planning effort.

For the Shamrock harvest none of the alternatives would affect lands classified as VMC 1. All the action alternatives would affect relatively small percentages of areas

classified VMC 2, 3, and 4 in the Shamrock area (Table 4-37). Alternative 2 would result in nearly twice as many acres of disturbance in areas classified VMC 2 as any of the other action alternatives. Under Alternative 2 portions of five units (7, 8, 37, 51, 55) would be located in areas classified VMC 2 compared to two units (7, 8) under Alternative 3, and four units (7, 8, 51-M, 37) under Alternatives 4 and 5.

Among the action alternatives, Alternative 2 would result in the most acres of disturbance in VMC 3 and would include portions of 20 units (15, 20, 23, 24, 28, 29, 31, 32, 33, 35, 36, 37, 40, 46, 48, 51, 52, 55, 61, 81). Conversely, Alternatives 3, 4, and 5 would result in greater acres of disturbance in VMC 4. For example, under Alternative 3 only two units (46, 20-M) would be in VMC 3 and 18 units in VMC 4. Similarly, Alternatives 4 and 5 would result in portions of nine units (46, 20, 28, 36, 37, 35, 48, 40, 52) and 13 units (15, 20, 23, 28, 35, 36, 37, 40, 46, 48, 61, 82, 83) respectively in VMC 3, and 17 and 13 units respectively in VMC 4.

Short-Term and Long-Term Impacts

For all the action alternatives, visitors to the area would notice disturbances in the landscape from logging and road construction activities in the short-term. These disturbances would be seen as part of distant views from some locations in Duncan Canal (Sensitivity Level 1), and select locations in Sumner and Keku Straits (Sensitivity Level 2). Landscape disturbances would be seen in the middleground and background views from the Petersburg-Tebenkof small plane route (Sensitivity Level 2).

Table 4-37
Harvest Unit Acres Within Each Visual Management Class (VMC) by Action Alternative

	Project	Alt 2		Alt 3		Alt 4		Alt 5	
	Area	Units	Acres	Units	Acres	Units	Acres	Units	Acres
VMC 1	202	0	0	0	0	0	0	0	0
VMC 2	6216	5	125	2	13	4	76	4	76
VMC 3	37,436	20	1,395	2	41	9	582	13	833
VMC 4	58,558	16	1,277	18	1,136	17	1,165	13	1,085

For all the action alternatives, landscape disturbances associated with harvesting would diversify the form, line, and texture of the characteristic landscape in the long-term. Interdiction of roads into the characteristic landscape may add some variety of form and line to the area, but may be viewed as disturbances in the long term. Development of roads will also provide access into the interior of the island, potentially increasing the visual sensitivity of the Shamrock area and the visual impacts associated with rock extraction along the road system.

Cumulative Effects

Since 1975 over 10,000 acres of land have been modified by timber harvesting, and over 100 miles of new permanent road have been constructed on Kupreanof Island (excluding the Lindenburg Peninsula). This past harvesting activity represents approximately 3.3 percent of the land base of the island. Future planned or probable timber harvest activities over the next eight to ten years could result in an additional 10,000 acres of disturbance (including the Shamrock harvest). Therefore, as a result of past, present, and future harvesting activity roughly seven percent of the land base on Kupreanof Island could eventually be affected by timber harvest activities by the year

2000. Cumulative effects on visual resources would be greater than seven percent because visual disturbance are seen in the context of the surrounding landscape and not as individual harvest units or roads. In addition, there is expected to be continued harvest of timber in areas of Kupreanof Island having a Timber Production LUD, which would result in greater cumulative effects over a 50 year timeframe.

Currently, the majority of Kupreanof Island is unroaded and access is via boat or plane. As a result of the Shamrock harvest anywhere from 25 miles (Alternative 3) to 42 miles (Alternative 2) of new, permanent road would be developed in the Shamrock area. The main collector road (6314) would be paved and range from 15.3 miles to 8.0 miles depending on the alternative, and would provide access to the central portion of Kupreanof Island. Under any of the action alternatives, this road would connect with the existing road system developed for the North Irish Timber Sale which provides roaded access to the town of Kake on the northwest corner of Kupreanof Island. The town of Kake is serviced by ferry from the mainland and other locations such as Petersburg.

Development of a paved road through the center of the island would result in increased visitation to the central area of Kupreanof Island. While most of the visitation to the island currently occurs along the shoreline via boat, future use could be dominated by vehicular access via the arterial road system. Therefore management of the viewshed of the arterial road would be important in maintaining the visual quality of the area for future visitors. While harvest units will green up and regenerate over time, visual impacts associated with rock extraction take much longer to reduce.

Mitigative Measures and Monitoring

New forestry practices such as green tree retention and group selection can have beneficial effects on social values such as scenic viewing and outdoor recreation in addition to enhancing biological diversity. Recent literature on the scenic attractiveness of various timber harvesting techniques support previous research on the aesthetic preferences for forested landscapes. Old-growth, mature forests are most attractive to forest visitors, clearcuts are least acceptable, and partial cutting methods such as green tree and snag retention fall somewhere in between (Brunson and Shelby, 1992; Ribe, 1989). Partial cutting methods including snag and green tree retention and feathering of unit edges were recommended for portions of several units in order to reduce the visual appearance of size of the units and to soften the visual contrasts created by the clearcut areas.

Mitigation was proposed for those units that were either seen from Duncan Canal or exceeded unit size guidelines (based on VQO and VAC settings) set forth in the Forest Plan Revision (USDA Forest Service, 1991a). Units seen from Duncan Canal in the background distance zone would include Units 22, 33, 55, and 61. Since Retention Factors apply to these units, extended 120 year rotation is recommended. A combination of green tree and snag tree retention is proposed for portions of those units that exceeded the recommended size guidelines which included Units 14, 25, 28, 29, 31, 32, 33, 36, 55, 61, and 81. Green tree retention at 5 trees per acre is proposed for portions of Units 14, 29, and 81 in areas proposed for shovel logging. Green tree retention at 15 trees per acre is proposed for portions of Units 36, 55, and 61. Snag retention at 2-5 trees per acre in areas to be shovel logged is proposed for Units 25 and 33. Units 31 and 32 are to be helicopter logged leaving two snags per acre. No mitigation is proposed for Unit 28. A creek buffer will separate the unit into two smaller visual disturbance areas.

Construction of permanent roads through the Shamrock area would provide for future recreational access into the area and viewing of the landscape. To enhance the visual

quality of the main road corridor and other potentially popular recreation areas such as the Irish Lakes area and the Castle River drainage, measures were recommended to screen rockpits and modify unit boundaries. Boundaries of Units 1 and 5 were modified to blend with the existing contours of the landscape, and rockpits located near Units 2, 23, 42, and 83 were proposed to be screened from the main road. Screening would be accomplished by providing fingers of vegetation between the road and rock pit.

Economics

The Forest Service is charged with the responsibility of providing timber from selected areas of the forest while conforming to standards and guidelines designed to protect the various other resources and the overall environment. Demand for Tongass timber is expected to remain strong during the 1990s (Haynes and Brooks, 1990). Therefore, one can assume that if a certain volume is not obtained from the Shamrock area, it will be obtained elsewhere. Thus, the employment, income and contribution to GNP attributable to the alternatives for this project are not considered new additions to the region's economy. However, these effects impact local economies. Also, the regional employment and income effects for each alternative allows an analysis of the relative efficiency of the alternatives for providing the regional jobs and income benefits sought through the Tongass timber sale program.

Employment

Assuming 4.7 direct jobs and 4 indirect jobs per MMBF of annual timber production, estimates can be made of the jobs generated by each action alternative. To do this, either an assumption must be made about the rate of production under each alternative, or a comparison must be made on the basis of total job contribution for each alternative to regional employment. There are two reasons for using a comparison of total jobs generated. One is that the rates of production from the Shamrock project area will most likely be controlled by market factors rather than by the nature of a particular action alternative. The second reason is that the jobs involve activities occurring over time. First there will be road and log storage facility developments, followed by logging, and then by milling activities. Thus, although the actual logging may take only three years under an alternative, the elapsed time from site development until the last log goes through the mill may be four or more years. The employment impacts in Table 4-38 are for the entire period of sale area operations. Alternative 2 would provide the most jobs, followed by Alternatives 5, 4, and 3. No new jobs would be created by Alternative 1 - no action.

Income

Assuming an annual income of $33,300 per job, the alternatives would produce total income to the region as shown in Table 4-38. Maximum income would be generated from Alternative 2, followed by Alternatives 5, 4, and 3. Alternative 3 generates about one-third the income as Alternative 2, whereas Alternatives 4 and 5 are about two-thirds of Alternative 2.

Gross National Product

Gross National Product (GNP) is the total value of the goods and services produced by the business activity of a region or nation. The best proxy for this value for the timber and wood products industry of Southeast Alaska is the estimated value of end products produced and sold during a period of time, or from a quantity of resources. The Forest Service appraisal procedure for the Tongass National Forest includes the

Table 4-38

Employment and Income Contributions to Regional Employment During Entire Operation for Each Alternative

Nature of Jobs	Number of Jobs for Each Alternative 1	2	3	4	5
Direct	NA	291	117	180	207
Indirect	NA	247	100	153	176
Total	**NA**	**538**	**217**	**333**	**383**
Total Income (millions)	NA	$17.90	$7.30	$11.10	$12.80

collection of data on the value of the products produced and sold from a thousand board feet of log scale during recent periods of time. These data were used to compare the contributions to GNP for each alternative. These differ by alternative due to differences in the volume produced and the quality of the timber (species and log grades) estimated for each alternative. Appendix G provides the sources of the value for each alternative.

Table 4-39 provides the contribution to GNP for each of the alternatives for the Shamrock project. Using an average of $550 per MBF and an allowable sale quantity of 418 MMBF per year, an average total contribution to the annual GNP for the Tongass National Forest would be $230,000,000. Alternative 2, if harvested over 3 years, for example, would provide slightly less than 4 percent of the Tongass National Forest's annual contribution to the GNP over that period. Alternative 3 would provide less than 2 percent under the same conditions.

Table 4-39

Contribution to Gross National Product During Entire Operation for Each Alternative

Alternative	Est. Total Volume to be Produced (MMBF)	Est. Net Sawlog Volume to be Produced (MMBF)	Est. End Product Value Per Thousand MBF	Est. Contributions to GNP
1	0.0	0.0	NA	NA
2	61.8	54.8	$553	$34,193,100
3	25.0	22.3	$551	$13,764,500
4	38.3	33.9	$552	$21,142,200
5	44.1	39.2	$552	$24,355,300

Timber Sale Economics

An economic analysis provides a basis of comparison and ranking of the five alternatives proposed for the Shamrock analysis area in economic terms. In this analysis, the net value per MBF for each alternative is derived by subtracting all production costs, including an allowance for profit and risk, from the end product selling values.

To account for market fluctuations, this analysis uses "middle-market" end product selling values. These values are the weighted average values for the past ten years, adjusted for inflation and an estimate of the timber quality found at Shamrock. Logging costs that were current at the time of posting the Notice of Intent for the Shamrock analysis are used. Because timber markets can vary significantly during a short time, the actual stumpage realized from this timber may change by as much as $100 per MBF or more.

Table 4-40 summarizes the timber values and costs calculated for each Shamrock alternative. Pond value is the middle market selling value, less manufacturing cost. Alternative 1, the no action alternative, is not shown since there is no harvest. The alternative volume shown includes utility, and an estimate of the right-of-way volume that would be cut during road construction. The difference in net value between alternatives can be attributed mainly to the ratio of road construction to sale volume.

The middle market pond value of the logs as shown in Table 4-40 is the result of averaging log values over a period of time selected to be "normal" for the markets for Southeast Alaska timber and wood products. These markets experience rather wide

Table 4-40
Timber Values and Costs to an Operator of Average Efficiency

	$/MBF Alternative			
	2	3	4	5
Total Volume (MBF)	61,832	24,981	38,301	44,122
Net Sawlog Volume (MBF)	54,774	22,299	33,854	39,178
Middle Market Pond Value ($/MBF)	$293	$291	$292	$292
Logging Costs $/MBF (except Spec Roads)	$273	$273	$271	$266
Specified Roads $/MBF	$112	$156	$139	$122
Subtotal Costs	**$385**	**$429**	**$410**	**$389**
Conversion Return	$-92	$-139	$-118	$-96
60% Normal Profit and Risk	$50	$50	$50	$50
Net Stumpage Value	**$-144**	**$-190**	**$-170**	**$-149**

fluctuations and the general tendency has been to increase at the rate of inflation plus some real price increases. Also, these values are the average for all the sellers of wood products; that is, they reflect the prices to the seller of average efficiency. Similarly, the costs for logging and processing the timber reflect the recent past experience of the operators of average efficiency. Thus, the negative net value for all the alternatives should not be interpreted to mean that such a timber sale offering would not be sold at the minimum acceptable rates or higher when offered in the future. Therefore, the results may be used in a comparative manner to evaluate the efficiency of the alternatives in providing timber supply to the regional economy.

Alternative 2 has the highest mid-market net stumpage value. Primarily, this is attributable to the reduction in development costs associated with larger volumes of timber to be harvested over a relatively smaller area. The largest single item of cost is the construction of specified roads. These are estimated to have an average cost of about $168,000 per mile. Even if this cost were cut in half, the net stumpage value at mid-market would still be a negative at $-86/MBF. Because these roads are permanent, they also have potential future value for future harvests in the area and for possible recreational use.

Alternative 2 has the lowest total log production costs at $385/MBF. However, this alternative still has a large negative conversion return of minus $-92 per thousand board feet before any profit allowance. None of the alternatives have a positive conversion return under the mid-market analysis of values and costs.

The alternatives are graphically ranked in Figures 4-7 and 4-8 according to highest value and lowest cost.

Other Environmental Considerations

Unavoidable Adverse Impacts

To the extent possible, impacts from action alternatives were lessened through the use of an interdisciplinary procedure (integrating comments and concerns from all resources) and comments from public scoping to select the location and extent of harvest units and roads. In addition, the application of Forest Plan Standards and Guidelines, BMPs, mitigative measures, and monitoring plans are intended to further limit the extent, severity, and duration of anticipated impacts. However, some adverse impacts to the environment cannot be avoided or mitigated. These impacts may be either transitory, short-term, or long-term in duration, and are described below.

Transitory impacts are expected to occur during the time of construction activity only. For example, diminished air quality could occur on a temporary basis due to road construction; timber harvest, timber hauling, and recreation traffic on untreated roads; and the operation of internal combustion engines. These activities would have localized and temporary adverse effects on air quality.

Short-term impacts generally occur during construction but may also extend to a few years following construction. For the Shamrock harvest, these impacts are within acceptable levels.

Most unavoidable adverse impacts are long-term, occurring for many years. One of the most significant adverse impact that affects most resources is the loss of old-growth forest. This vegetation alteration results in changes to wildlife species richness and abundance wherever harvesting occurs. Species dependent on old-growth would no longer utilize areas harvested. A return to old-growth forested ecosystems

Figure 4-7
Graphic Ranking of Alternatives by Value, Cost, and Net Return

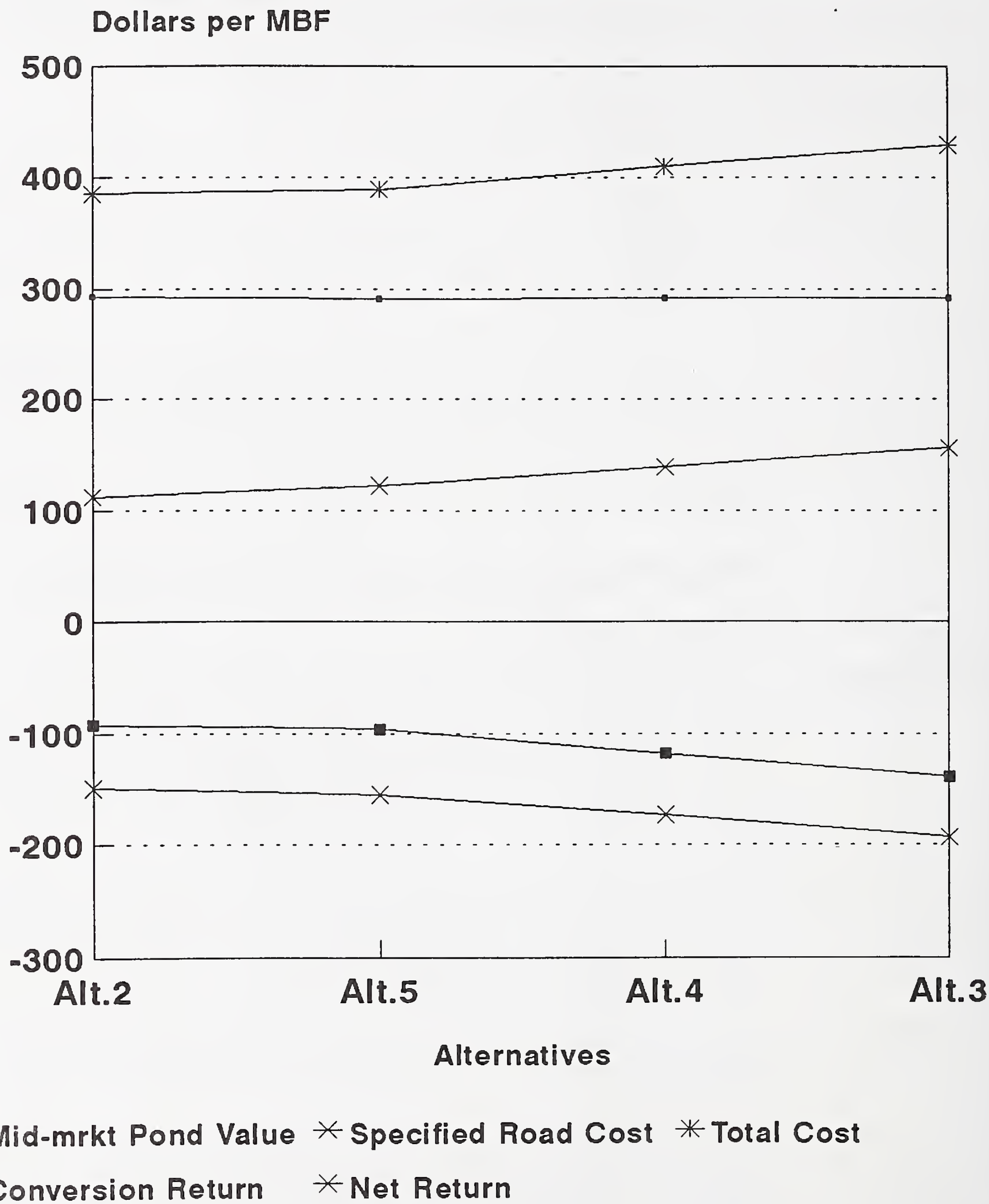
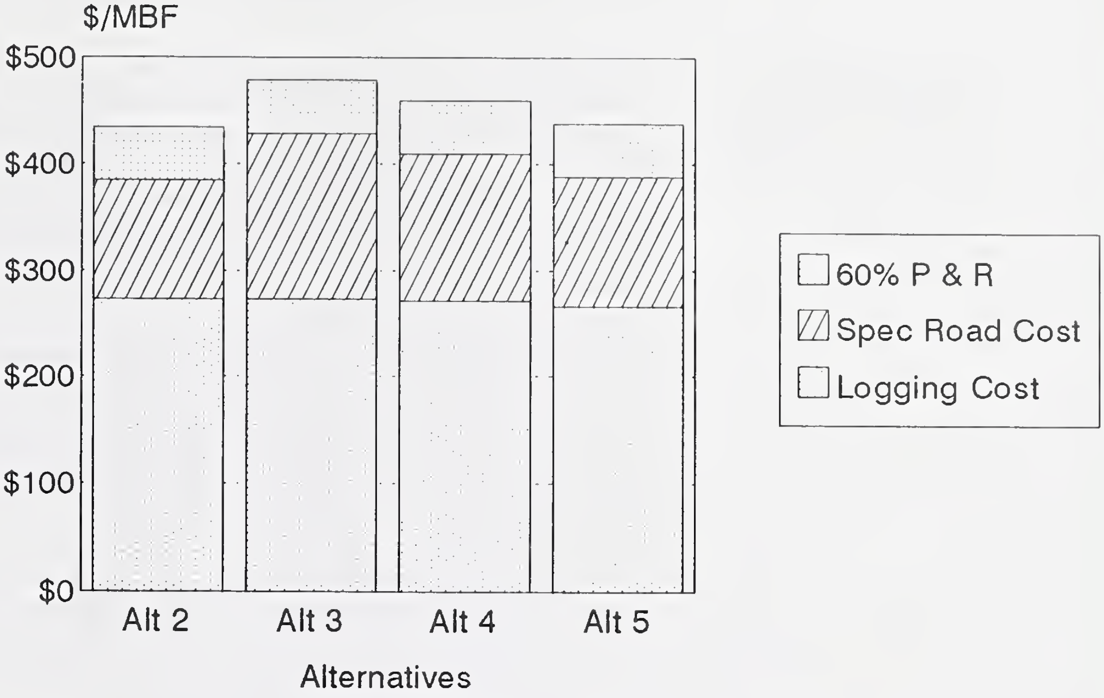


Figure 4-8
Shamrock Appraisal by Action Alternatives



generally would require a minimum of 100 years. Affects on biodiversity are difficult to quantify for a single harvest within the Shamrock area. These types of impacts are best understood and treated on a landscape basis, and thus would become most apparent only after effects are cumulative over several harvest entries.

Harvesting also results in increased water temperatures wherever vegetation that shades streams is removed. Because Class I and II streams would have vegetated buffers of 100 feet, stream temperature increases are generally confined to Class III streams and areas where Class III streams flow into Class I or II streams.

The combined affects of timber harvest and road construction on ground disturbance result in erosion and sediment production. Sediment production would occur from timber harvest and construction and use of roads. Sediment would be produced by surface erosion, channel erosion, and mass movement. Sediment loads in streams displace fish, reduce anadromous and resident fish reproductive success, and alter aquatic invertebrate populations.

Visual resources are also affected by harvesting, road construction, and rock extraction. These activities would introduce visual contrasts of form, line, color, and texture into the Shamrock area. Visual contrasts would be experienced by visitors in the short-term, although over time the visual contrasts would diminish as the overstory matures and blends into the surrounding landscape.

Increased public assess through road construction affects subsistence, fisheries, and recreation. Competition for subsistence resources and increased angling pressure would occur indirectly from road construction, as semi-primitive non-motorized and roaded modified opportunities replace the existing primitive recreational opportunities. Implementation of the action alternatives would result in a loss of opportunity to consider the Shamrock area for future revisions of the Forest Plan, for designation as Wilderness, as Research Natural Areas, or for other purposes requiring natural characteristics.

Relationship Between Short-term Uses and Long-term Productivity

All alternatives would come under the mandate of the Multiple Use and Sustained Yield Act of 1960, which requires the Forest Service to manage National Forest lands for multiple uses, including timber, recreation, fish and wildlife, range, and watershed. All renewable resources are to be managed such that they are available for future generations. The harvesting and use of standing timber can be considered a short-term use of a renewable resource. As a renewable resource, trees can be reestablished and grow again if the productivity of the land is not impaired.

Timber harvest results in the creation of new timber stands and increased growth rates. Old-growth forests are characterized by low or no net growth with annual growth being offset by mortality (Hutchison and Lebau, 1975). The replacement of young, second-growth stands could double the volume growth produced over a 100-year-old rotation on an average site (Taylor, 1934). In areas that would be precommercially thinned, the amount of usable fiber available for industrial use would be increased.

Under current and proposed management direction, the time between the harvest proposed for the Shamrock EIS and a subsequent harvest on the same area is estimated at approximately 100 years. After 100 years, these cut stands would be considered for another harvest. Long-term productivity is not expected to be affected from repeated harvest cuts on 100-year rotations.

Short-term use could result in sediment and temperature related impacts to streams. Revegetation of harvest areas over time should significantly reduce these impacts so that long-term productivity is unaffected. Permanent roads would continue to contribute some sediment over time, and could have a small impact on long-term productivity of fish resources.

Soil and water are two key factors in ecosystem productivity, and these resources would be protected in all alternatives to avoid damage that could take many decades to rectify. Sustained yield of timber, wildlife habitat, and other renewable resources all rely on maintaining long-term soil productivity. Quality and quantity of water from the Shamrock area may fluctuate as a result of short-term uses, but no long-term effects to the water resource are expected to occur as a result of timber management activities.

All alternatives would provide the fish and wildlife habitat necessary to maintain existing known populations of native and nonnative species throughout the Shamrock area. The acreage to be harvested is less that five percent of the study area, and previous harvests are less than one percent of the study area and are confined to the northern portion of the Shamrock area. Wildlife species richness and abundance also depend on the quality, quantity, and distribution of habitat, whether used for breeding, feeding, or resting. The standards, guidelines, and mitigative measures that would be implemented for the Shamrock harvest would maintain long-term habitat and species productivity.

The harvesting of forest land is a trade-off between the immediate, short-term extraction and use of timber and long-term biodiversity of unharvested old-growth forest. Because there is a relatively small proportion of the landscape that is subject to proposed harvesting in the Shamrock area, only a correspondingly small loss of long-term biodiversity would be associated with the short-term extraction of timber. These trade-offs would become significant only when the cumulative effects of several harvest entries into the Shamrock and surrounding areas result in substantially more fragmentation of old-growth habitat.

Subsistence resources would be affected in the short-term through loss or alteration of some wildlife habitat, and degradation of water and air quality. Revegetation of harvested areas and the completion of logging activities should significantly reduce the possibility of long-term effects to productivity. Permanent roads may provide improved access, which could result in a long-term increase in competition for subsistence resources.

Irreversible and Irretrievable Commitment of Resources

Irreversible commitments of resources are decisions to use, modify, or otherwise affect nonrenewable resources such as cultural resources or minerals. Irreversible commitments could also apply to resources that are renewable only over a long period of time such as soils productivity or old-growth forests. Such commitments of resources are considered irreversible because the resource has deteriorated to the point that renewal can occur only over a long period of time or at a great expense, or the resource has been destroyed or removed. All alternatives result in some irreversible commitments, although the extent and potential for adverse effects increase in alternatives that emphasize resource extraction and utilization.

Irretrievable commitments represent opportunities foregone for the period of the proposed actions, during which other resource utilization cannot be realized. These decisions are reversible, but the lost opportunities for utilization are irretrievable. Under multiple-use management, some irretrievable commitments of resources are unavoidable due to the mutually exclusive relationship between some resources. An example of such a commitment is development at logging camps that will be removed at the completion of logging activities. These developments occupy approximately 3 to 5 acres, and include bunkhouses, mobile homes, fuel storage facilities, etc. For the 3 to 5 years that such developments exist, the opportunity to otherwise utilize these areas is foregone, thus irretrievable.

A proposed timber harvest is a major, long-term commitment of resources such as wildlife habitat, that extends in time well beyond the typical land-use planning time-frame. Harvesting of old-growth timber is considered an irreversible loss, because stands may take 200 to 300 years to return to existing ecosystem conditions. Some wildlife, adapted only to old-growth conditions, would be irreversibly lost from the harvested areas until this time. Permanent road construction would also result in irreversible loss of wildlife habitat.

In addition to loss of wildlife habitat, permanent road construction would result in loss of wetlands and an irreversible change in the accessibility of fish and subsistence resources. Soil productivity would be eliminated in landings and rockpits.

Irreversible disturbance of some types of cultural resources may occur as a consequence of management activities. This would be especially true for subsurface resources that cannot be located through surface surveys. Even with mitigation, unanticipated or unavoidable disturbances can result in the loss of cultural values. Mitigation efforts such as data recovery involve the scientific and controlled

destruction of a cultural resource site. Once undertaken, the effects are irreversible and the mitigation effort becomes an irretrievable commitment to the resource.

The use of energy resources and the removal of mineral resources are irreversible commitments of resources. The utilization of rock resources for road and facility construction would be an example. The use of fossil fuels during project administration activities would be an irreversible resource commitment. Alternatives vary by the amount of energy and mineral resources used; only the no action alternative abstains from the use of these nonrenewable resources at this time.

In unroaded areas, development activities such as timber harvest and the road construction associated with harvest would irreversibly reduce the potential amount of area that could be designated as a part of National Wilderness Preservation System, managed as a Research Natural Area, or managed for other purposes requiring natural characteristics. Roads and harvests proposed in the Castle River Wild and Scenic River corridor under Alternative 2 could affect its eligibility for designation. Although such actions would not preclude the river from inclusion in the Wild and Scenic River System, they may irreversibly impact its designation as a "wild" river.

In the short-term, recreation experiences would be directly affected by road construction and timber harvesting, including the presence of heavy equipment in the area. Over time, as the harvest units revegetate and the modification of the landscape becomes less evident to visitors, roaded modified opportunities would be replaced by semi-primitive motorized recreation opportunities. Construction of permanent roads would contribute to long-term public access into the area for recreation.

The majority of the Shamrock area (93 percent) is currently viewed as roadless, unmodified landscape where only ecological change occurs. Introduction of harvest units, roads, and rockpits would permanently alter the undeveloped character and old-growth qualities of the Shamrock area. Most of the proposed modification would not be seen from the saltwater boat routes that surround the island, but would be seen from the southern (Petersburg-Tebenkof Bay) plan route and by visitors accessing the area via the road system to be constructed. In addition, green-up of harvested land would occur, and visual contrasts would begin to soften in five years, with an eventual return to old-growth forest in 200 years. Most of the proposed road miles, and rockpits would result in permanent alterations to the existing unmodified landscape.

Possible Conflicts with Plans and Policies of Other Jurisdictions

The regulations for implementing NEPA require a determination of possible conflicts between the proposed action and the objectives of federal, state, and local land use plans, policies, and controls for the area. The major land use regulations of concern are the Coastal Zone Management Act (CZMA), Section 810 of ANILCA, the Federal Clean Water Act, state air pollution standards, and the State of Alaska's Forest Practices Act. A discussion of each of these determinations is presented below.

Coastal Zone Management Act of 1976 (CZMA)

The CZMA was passed by Congress in 1976 and amended in 1990. This law, as amended, requires Federal agencies conducting activities or undertaking development affecting the coastal zone to ensure that the activities or developments are consistent with approved State coastal management programs to the maximum extent practicable. The State of Alaska passed the Alaska Coastal Management Act in 1977 to establish a program that meets the requirements of the CZMA. It contains the standards and criteria for a determination of consistency for activities within the coastal zone.

Forest Service requirement for consistency are detailed in a Memorandum of Understanding between the State of Alaska and the Regional Forester, dated October 8, 1981. Standards against which the consistency evaluation will take place are: Alaska Statute Title 46, Water, Air Energy, and Environmental Conservation; Alaska Forest Practices Act of 1990; and the District Coastal Management Program.

Minerals

There are no potential conflicts associated with minerals within the Shamrock area.

Subsistence

The actions proposed in this document have been examined to determine whether they are consistent with the sound management of public lands. There are no conflicts with policy, objectives, or adopted plans in any of the following documents: (1) National Forest Management Act, (2) Alaska National Interest Lands Management Plan, (3) Tongass Land Management Plan, (4) Tongass Timber Reform Act, and (5) Alaska National Interest Lands Conservation Act.

Cultural Resources

Federal legislation for the protection of cultural resources on public land requires consultation with the State Historic Preservation Officer when federally funded or licensed undertakings have the potential to effect cultural resources. The objective of the Forest Service Heritage Program is to preserve significant cultural resources in their field setting and ensure that they remain available in the future for research, educational, social, and recreational purposes. To this end, adequate standards, guidelines, and procedures to protect cultural resources and meet the goals of the Heritage Program have been developed.

Recreation

None of the alternatives conflict with the plans, policies, or objectives of other jurisdictions for recreation.

Visual Resources

There are no anticipated conflicts with the plans, policies, and objectives of other jurisdictions regarding visual resources.

Alaska National Interest Lands Conservation Act of 1980 (ANILCA)

Under Section 810 of ANILCA, agencies are required to evaluate the effects of proposed actions on subsistence uses of Federal land and to determine if the proposed action may significantly restrict subsistence opportunities. Refer to the *Subsistence* section of this chapter for the evaluation of impacts to subsistence use as a result of the alternatives.

Clean Water Act

Federal Clean Water Act of 1972, as amended in 1977 and the MOA signed between the Forest Service and the Alaska Department of Environmental Conservation require the Forest Service to comply with all federal and state water quality regulations. This

act provides a means to protect and improve the quality of the water resources and maintain their beneficial uses. All alternatives will comply with these standards.

Air Quality Standards

The Shamrock area is governed by ambient particulate standards of 60 $\mu g/m^3$(24-hr). Additionally, the region is classified as a Class II area, which establishes a particulate matter increment for allowable increases above baseline levels. The increments for particulate matter in a Class II area are in annual geometric mean of 19 $\mu g/m^3$. The Shamrock vicinity is presently in compliance with these standards. The proposed logging activity will not change this status.

State of Alaska's Forest Practices Act of 1990

On May 11, 1990, Governor Cowper approved the legislature's major revision of the State's Forest Practices Act (FPA). The revised act significantly increases the State's role in providing protection and management for important forest resources on State and private lands. The revised Forest Practices Act will also affect National Forest management through its relationship to the ACMP and the Federal CZMA (see above discussion).

For National Forest timber operations, such as proposed for the Shamrock area, the effect of the revised Forest Practices Act is essentially two-fold. First, it clarifies that the revised Forest Practices Act is the standard which must be used for evaluating timber harvest activities on Federal lands for purposes of determining consistency to the maximum extent practicable with the Alaska Coastal Zone Management Program. Secondly, it calls for minimum 100-foot buffers on all Class I streams, and recognizes that consistency to the maximum extent possible for purposes of the Alaska Coastal Management Program is attainable in Federal timber harvest activities using specific

Fishing and timber harvest are economic mainstays of Southeast Alaska

methodologies which may differ from those required by the revised Forest Practices Act or its implementing regulations.

The TTRA prohibited commercial timber harvesting within buffer zones established on all Class I streams and those Class II streams which flow directly into a Class I stream. Buffer zones have a minimum width of 100-feet slope distance from the edge of either side of the stream. In addition, the Forest Service is currently working with the Alaska State Division of Government Coordination on a revision of the MOU between the State and the Forest Service. This revised MOU will establish the policies and procedures for coordinating State review of Forest Service programs and activities, including those covered by the Forest Practices Act and the Alaska Coastal Management Program.

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Alaska Department of Fish & Game, Ketchikan
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Alaska Operations, Anchorage
US EPA, Alaska Operations, Juneau
US EPA, EIS Review Coordinator, Region X, Seattle, WA
USDA, Forest Service, Director Environmental Coordinator Washington, D.C.
USDA, Forest Service, Chugach National Forest, Anchorage
USDA, Forest Service, Tongass NF, Chatham Area, Sitka
USDA, Forest Service, Tongass NF, Stikine Area, Petersburg
USDA, National Agriculture Library Head, Acquisitions and Serials Beltsville, MD
USDA, Soil Conservation Service, Anchorage
USDI, Bureau of Mines, Juneau
USDI, Fish & Wildlife Service, Anchorage
USDI, Fish & Wildlife Service, Juneau
USDI, Office of Environmental Affairs, Washington, D.C.
US Federal Agency Liaison Division, Washington, D.C.
Utah State University, Natural Resources Library, Logan, UT
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Woolly Mammoth Construction Co., Wrangell
Wrangell, City of
Wrangell Public Library
Wrangell Resource Council
Honorable Don Young, U.S. House of Representatives
Roger M. Ziesak

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Glossary & List of Acronyms

Glossary

Alaska National Interest Lands Conservation Act (ANILCA)
Passed by Congress in 1980, this legislation designated 14 National Forest wilderness areas in Southeast Alaska. In section 705(a) Congress directed that at least $40,000,000 be made available annually to the Tongass Timber Supply Fund to maintain the timber supply from the Tongass National Forest at a rate of 4.5 billion board feet per decade. Section 810 requires evaluations of subsistence impacts before changing the use of these lands.

Alaska Native Claims Settlement Act (ANCSA)
Enacted December 18, 1971, ANCSA provides for the settlement of certain land claims of Alaska natives and for other purposes.

Allowable Sale Quantity (ASQ)
ASQ refers to the maximum quantity of timber that may be sold each decade from the Tongass National Forest. This quantity expressed as a board foot measure is calculated per timber utilization standards specified in the Alaska Regional Guide, the number and type of acres available for timber management, and the intensity of timber management. The ASQ was calculated at 4.5 billion board feet per decade for the Tongass National Forest.

Anadromous Fish
Anadromous fish (such as salmon, steelhead, and shad) spend part of their lives in fresh water and part of their lives in salt water.

Anaerobic Conditions
Conditions under which oxygen is absent from the environment.

Aquatic Habitat
Includes any region of open-water potentially utilized by animal species, such as bogs, creeks, streams, rivers, ponds, lakes, estuaries, or marine waters.

Aquatic Habitat Management Unit (AHMU)
A mapping unit that displays an identified value for aquatic resources. It is a mechanism for carrying out aquatic resource management policy.

> *Class I AHMU:* Streams with anadromous or high quality sport fish habitat. Also included is the habitat upstream from a migration barrier known to have reasonable enhancement opportunities for anadromous fish. Often referred to as Class I streams.

Class II AHMU: Streams with resident fish populations and generally steep (6 to 15 percent) gradient (can also include streams from 0 to 6 percent gradient where no anadromous fish occur). These populations have limited sport fisheries values and are separate from the high quality sport fishing systems included in Class I. They generally occur upstream of migration barriers or are steep gradient streams with other habitat features that preclude anadromous fish use. Often referred to as Class II streams.

Class III AHMU: Streams with no fish populations but have potential water quality influence on the downstream aquatic habitat. Often referred to as Class III streams.

Archaeological Resources Protection Act
1979 legislation requiring a permit for any excavation or removal of archeological resources from public or Indian lands. The act provides both civil and criminal penalties for violation of permit requirements.

Arterial Road
A forest road that provides service to large land areas and usually connects with other arterial roads or public highways.

Artifact
Any object made, modified, or used by man. Anything that exhibits physical attributes assumed to be the result of human activity.

Beach Fringe Habitat
Habitat that occurs from the intertidal zone inland 500 feet, and islands of less than 50 acres.

Best Management Practice (BMP)
A practice or combination of practices that, after problem assessment, examination of alternative practices, and appropriate public participation is determined to be the most effective and practicable means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals. A BMP is not a site-specific prescription but an action-initiating mechanism which eventually leads to the interdisciplinary development of a site-specific prescription.

Biodiversity
A concept applied to a given area or region that includes the variety of and variability among living organisms and the ecological complexes in which they occur. In Southeast Alaska, biodiversity is most often associated with the array of species dependent on old-growth forest habitat.

Bog
Wetland's dominated by sphagnum moss whose only water source is rainwater. Bogs are generally extremely low in nutrients, form acidic peats, and occur in northern latitudes.

Buffer
Tongass Timber Reform Act requires that timber harvest be prohibited in an area no less than 100 feet in width on each side of all Class I streams and Class II streams which flow directly into Class I streams. This 100-foot area is known as a buffer.

Carrying Capacity
The theoretical population size of a particular species that a defined area could support.

Class I, II, III Streams
See Aquatic Habitat Management Unit

Clearcutting
A method of regeneration cutting in which the old crop is completely cut in designated patches. Regeneration in the Alaska Region is usually natural; and the size of the clearcut area can exceed 100 acres only under certain situations.

Collector Road
A forest road that serves smaller land areas than an arterial road. Usually connects forest arterial roads to forest local roads or terminal facilities. Collector roads are usually long term facilities.

Commercial Fishery
Fish, shellfish, or other fishery resources taken or possessed within a designated area for commercial purposes.

Commercial Forest Land (CFL)
Forest land that is producing or capable of producing crops of industrial wood and is not withdrawn from timber utilization by statute or administrative regulation. This includes areas suitable for management and generally capable of producing in excess of 20 cubic feet per acre of annual growth or in excess of 8,000 board feet net volume per acre. It includes accessible and inaccessible areas.

Cultural Chronology
The historic and spatial framework for describing the development of human societies and cultures, and the documented processes of cultural change involved in this development.

Cultural Resource Sensitivity Zones
Areas determined by a Tongass National Forest predictive model to have high, medium, and low site potential, based largely on elevation and slope angle criteria.

Cultural Resources
Historic or prehistoric objects (i.e., artifacts), sites, buildings, structures, and so on that result from past human activities.

Culturally Modified Tree (CMT)
A tree which has been intentionally altered by Native people participating in the traditional utilization of the forest.

Cumulative Effects
Impacts on the environment resulting from past, present, and reasonable foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions occurring over time.

Glossary and Acronyms

Direct Jobs
The jobs that are immediately associated with the Long-Term Contract timber sale including for example logging sawmills and pulp mills.

Directional Falling
The use of specialized equipment, such as hydraulic jacks, to influence the direction of tree falling.

Draft Environmental Impact Statement
Section 102 of the National Environmental Policy Act (NEPA) requires that a statement of environmental effects for a major Federal action be released to the public and other agencies for comment and review prior to a final management decision.

Ecosystem
A complete, interacting system of organisms considered together with their environment (for example; a marsh, a watershed, or a lake).

Endangered Species Act of 1973
The legislation establishing regulatory protocols and protection for species recognized by the federal government as threatened or endangered.

Environmental Assessment
The process, formalized in production of Draft and Final Environmental Impact Statements, of evaluating the existing conditions (for multiple resource categories) of a proposed project site, and the anticipated changes to that site arising from proposed management alternatives.

Estuary Fringe Habitat
A 1,000-foot zone around an estuary.

Estuary
For the purpose of this EIS process, estuary refers to the relative flat intertidal and adjacent upland areas generally found at the heads of bays and mouths of streams. They are predominantly mud and grass flats and are unforested except for scattered spruce or cottonwood.

Even-Aged Management
The application of a combination of actions that result in the creation of stands in which trees of essentially the same age grow together. Clearcutting is an example of this type of management.

Existing Visual Condition (EVC)
The level of visual quality or condition presently occurring on the ground. The six existing visual condition categories are:

> *Type I:* These areas appear to be untouched by human activities.
>
> *Type II:* Areas in which changes in the landscape are not noticed by the average person unless pointed out.
>
> *Type III:* Areas in which changes in the landscape are noticed by the average person but they do not attract attention. The natural appearance of the landscape still remains dominant.

Type IV: Areas in which changes in the landscape are easily noticed by the average person and may attract some attention. Although the change in landscape is noticeable, it may resemble a natural disturbance.

Type V: Areas in which changes in the landscape are obvious to the average person. These changes appear to be major disturbances.

Type VI: Areas in which changes in the landscape are in glaring contrast to the natural landscape. The changes appear to be drastic disturbances.

Feature
A non-portable cultural element of a site that is not classed as an individual artifact. Often a distinct association of cultural elements.

Fen
A peat forming wetland that receives nutrients from sources other than precipitation, usually through groundwater movement. Fens have peats that are not acidic.

Fish Habitat
The aquatic environment and the immediately surrounding terrestrial environment that combined afford the necessary physical and biological support systems required by fish species during various life stages.

Floodplain
The lowland and relatively flat areas along inland and coastal waters, including debris cones and flood-prone areas of offshore islands; including at a minimum that area subject to a 1 percent (100-year recurrence) or greater change of flooding in any given year.

Forest and Rangeland Renewable Resources Planning Act of 1974
Amended in 1976 by the National Forest Management Act.

Forested Habitat
All areas with forest cover. Used in this EIS to represent a general habitat zone.

Fragmentation
The breaking up of large areas of old-growth forest by clearcutting. As the number of clearcut harvest units within a contiguous block of forest increases, the block of forest is reduced in size and/or broken into smaller blocks. This kind of fragmentation is known to have a detrimental effect on several old-growth dependent wildlife species.

Geographic Information System (GIS)
An information processing technology to input, store, manipulate, analyze, display spatial, and attribute data to support the decision making process. It is a system of computer maps with corresponding site specific information that can be electronically combined to provide reports and maps.

Green Tree
A living tree, retained in a clearcut, to provide potential wildlife habitat (in the form of a perching, nesting, roosting, or feeding site), as well as providing potential snag material in the future. Also contributes to softening of visual effects of clearcutting.

Gross National Product
The total value of goods and services by the business activity of a region or nation.

Group Selection
Removal of groups of trees, creating openings large enough (1/2 - 3 acres) for adequate regeneration of a selected species.

Habitat Capability Model
Computer-based estimate of habitat suitability based on a quantified characterization of the particular habitat requirements for a species combined with a quantified characterization of conditions within a region.

Habitat Capability
The number of healthy animals that a habitat can sustain.

Habitat Conservation Area (HCA)
A patch of habitat that is maintained in largely natural condition to maintain viable populations of a particular species or group of similar species. It is usually part of a larger network of HCAs that facilitate movement of individuals among populations.

Habitat Suitability and Habitat Suitability Index (HSI)
A computer-generated mathematical prediction of the relative ability of a defined region to support a particular species whose habitat requirements are known and codified within a habitat capability model. The suitability index (HSI) ranges from 0 to 1, with 0 meaning that the habitat is incapable of supporting the particular species, and HSI=1 indicating that the habitat is optimal for the species. An intermediate index reflects the potential for the habitat to support a proportion of the individuals that could be sustained under optimal conditions. For the Shamrock EIS, habitat suitability is defined in four categories: "good" ($0.7 < HSI \leq 1$); "average" ($0.3 < HSI \leq 0.7$); "below-average" ($0 < HSI \leq 0.3$); and "unsuitable" (HSI=0).

Herpetological Species
A collective name referring to amphibian and reptilian wildlife species.

Humics

Dark organic substances of indefinite composition that commonly occur in waters of streams, lakes, and wetlands where surrounding soils are rich in organic matter.

Hydric Soils
A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation.

Indirect Jobs
The jobs in service industries that are associated with the Long-Term Contract timber sale including for example suppliers of logging and milling equipment.

Interdisciplinary Team (IDT)
A group of people with different professional backgrounds assembled to solve a problem or perform a task.

Knutsen-Vandenberg Act (KV)
The Act was passed by Congress in 1930 and amended in 1976 to provide for reforestation, resource protection, and improvement projects in timber sale areas. These funds are collected as a portion of the stumpage fee paid by the purchaser. Examples of such projects are stream bank stabilization, fish passage structures, and wildlife habitat improvement.

Land Use designation (LUD)
The method of classifying land uses presented in the Tongass Land Management Plan (TLMP). Land uses and activities are grouped to define a compatible combination of management activities along with a set of coordinating policies. The following is a description of the four classifications:

> *LUD:* Wilderness areas.
>
> *LUD II:* These lands are to be managed in a roadless state in order to retain their wildland character, but this designation would permit wildlife and fish habitat improvement as well as primitive recreation facility and road development under special authorization.
>
> *LUD III:* These lands may be managed for a variety of uses. The emphasis is on management for uses and activities in a compatible and complimentary manner to provide the greatest combination of benefits.
>
> *LUD IV:* These lands provide opportunities for intensive resource use and development where the emphasis is primarily on commodity or market resources.

Large Woody Debris (LWD)
Any large piece of relatively stable woody material having a diameter of greater than 10 centimeters and a length greater than one meter that intrudes into the stream channel or occurs on the forest floor.

Layout
Planning and mapping (using aerial photos) of harvest and road systems needed for total harvest of a given area.

Logging Systems

> *Skidder:* A system of log transportation in which logs are pulled from the woods to a landing by means of a crawler tractor, skidder, or similar ground-based equipment.
>
> *High-lead:* A system of cable logging in which the working lines are elevated at the landing area by a rigged wooden tree or portable steel spar.
>
> *Skyline:* A system of cable logging in which all or part of the weight of the logs is supported during yarding by a suspended cable.
>
> *Helicopter:* A system of transporting logs from the woods to a landing as an external load on a helicopter.

Log Transfer Facility (LTF)
A facility that is used for transferring logs from land to water. It is wholly or partially constructed in waters of the United States and siting and construction are regulated by the 1987 Amendments to the Clean Water Act. Formerly termed terminal transfer facility.

Mammal Sign
Any indirect evidence of mammalian activity as opposed to direct, visual observation of an organism. Examples include scat (feces), scratchings, tracks, and evidence of feeding.

Management Indicator Species (MIS)
The following categories were used where appropriate: endangered and threatened plant and animal species identified on State and Federal lists; species with special habitat needs that may be influenced significantly by planned management programs; species commonly hunted, fished, or trapped; nongame species of special interest; additional plant or animal selected because their population changes are believed to indicate effects of management activities on other species of a major biological community or on water quality.

Marginal Habitat
See Habitat Suitability

Microblade
A specific type of small, thin blade tool with roughly parallel sides and a prepared proximal end. Often made from chert or obsidian.

Midden
A deposit of occupation debris, rubbish, or other by-products of human activity.

Mitigation
These measures include avoiding an impact by not taking a certain action or part of an action, minimizing an impact by limiting the degree or magnitude of an action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or compensating for the impact by replacing or providing substitute resources or environments.

Muskeg
A bog, often dominated by sphagnum moss, frequently with deep accumulations of organic material, occurring in wet, poorly drained boreal regions.

National Environmental Policy Act (NEPA)
Passed by congress in 1969, NEPA declared a national policy to encourage a productive harmony between humans and their environment, to promote efforts that will prevent or eliminate damage to the environment and the biosphere and stimulate the health and welfare of humans, to enrich the understanding of the ecological systems and natural resources important to the nation, and to establish a Council on Environmental Quality. This act requires the preparation of environmental impact statements for federal actions that are determined to be of major significance.

National Forest Management Act (NFMA)
A law passed in 1976 that amends the Forest and Rangeland Renewable Resources Planning Act and requires the preparation of Forest plans.

National Historic Preservation Act
1966 legislation establishing the National Register of Historic Places and extending the national historic preservation programs to properties of state and local significance.

National Register of Historic Places
Official federal list of districts, sites, buildings, structures, and objects significant in American history, architecture, archeology, engineering and culture.

National Wild and Scenic River System
Rivers with outstanding scenic, recreational, geological, fish and wildlife, historic, cultural, or other similar values designated by Congress under the Wild and Scenic Rivers Act for preservation of their free-flowing condition.

Net Sawlog Volume
Volume of wood-fiber of suitable size and quantity that can be processed into lumber.

Non-Commercial Species
Species that have no economic value at the present time and no anticipated timber value within the near future.

Nonforest Habitat
Land that has never supported forests, land formerly forested but now developed for nonforest uses, or land with less than 10 percent cover of commercial tree species.

Notice of Intent (NOI)
Notice of Intent was submitted to indicate an intention to produce this EIS.

Old-Growth Forest
Old-growth stands are characterized by trees well past the age of maturity (dominant trees typically exceed 300 years in age). Stands exhibit declining growth rates and signs of decadence such as dead and dying trees snags and downed woody material. Stands include trees of all ages, multilayered canopies, a range of tree diameter sizes (including very large diameter trees up to and exceeding 3 meters), and the notable presence of understory vegetation. Old growth stands are defined in the TLMP inventory as those stands having the majority of timber volume in trees more than 150 years of age.

Optimal Habitat
See Habitat Suitability

Overmature
The stage at which a tree declines in vigor and soundness, for example, height growth has usually stopped and probability of mortality is high.

Overstory
In a stand with several vegetative layers the overstory is the uppermost layer usually formed by the tallest trees.

Parent Material
The unconsolidated, and more or less chemically weathered, mineral, or organic matter from which soils develop.

> ***Residuum:*** parent material developed in place.
>
> ***Colluvium:*** parent material derived from debris deposited by gravity.
>
> ***Glacial Deposits:*** parent material created as a result of glacial action.

Partial Cutting
Any cutting other than a clearcut. This may include thinning, selection, shelterwood, or an overstory removal.

Petroglyph
Any drawing or picture incised or pecked on a rock. Often highly stylized or geometric in nature.

Pond Value
The selling value of timber without the manufacturing cost.

Precommercial Thinning
The practice of removing some of the trees of less than marketable size from a stand in order to achieve various management objectives.

Primitive I
A Recreation Opportunity Spectrum class that includes areas out of sight and sound of human activities and greater than 3 miles from roads open to public travel and marine travelways. Provides opportunities having a high degree of interaction with the natural environment, challenge risk, and the use of outdoor skills.

Primitive II
A Recreation Opportunity Spectrum class that is similar in appearance to Primitive I ROS class; however, is accessible by marine travelway or is within 1/4 mile of low use trails.

Purchaser
The term used to describe the buyer of the Forest Service Timber Sale Contract.

Recreation Opportunity Spectrum (ROS)
The framework for planning and managing the recreation resource that consists of six classes from primitive to urban. Each ROS class is defined in terms of its setting and the recreational experiences offered in that setting. Other factors also play a role in defining the ROS class, including the extent to which the natural environment has been modified, the type of facilities developed, and the degree of outdoor skills needed to enjoy the area.

> *Primitive I:* Includes areas out of sight and sound of human activities and greater than 3 miles from roads open to public travel and marine travelways. Provides opportunities having a high degree of interaction with the natural environment, challenge risk, and the use of outdoor skills.
>
> *Primitive II:* Area is similar in appearance to Primitive I ROS class; however, is accessible by marine travelway or is within 1/4 mile of low use trails.

Semi-Primitive Nonmotorized: Includes areas greater than 1/4 mile and less than 3 miles from all roads trails or readily accessible marine travelways. Provides limited opportunities for isolation from the sights and sounds of humans, a high degree of interaction with the natural environment, moderate challenge risk, and the opportunity to use outdoor skills.

Semi-Primitive Motorized: Includes areas less than 1/4 mile from primitive roads, trail, or readily accessible marine travelways. Characterized by a predominantly unmodified natural environment with minimum evidence of sights and sounds of humans. Road access is not maintained in these areas.

Roaded Natural: Areas are less than 1/4 mile from roads open to public travel, major power lines, and areas of timber harvest. Areas are characterized by predominantly natural environments with moderate evidence of sights and sounds of humans.

Roaded Modified: Areas are less than 1/4 mile from areas of timber harvest and transportation corridors. Areas are characterized by modified natural environment where utilization practices are common and are for purposes other than recreation.

Rural: Includes those areas with small communities, developed campgrounds, and administrative sites. These areas are characterized by substantially modified natural environments. Sights and sounds of humans are readily evident.

Urban: Areas characterized by substantially urbanized environment. The background may have elements of a natural environment. Timber harvest activities and utilization practices are common. Sights and sounds of humans predominant. Large numbers of visitors can be expected on site and in nearby areas.

Recreation Places
Identified geographic areas having one or more physical characteristics that are particularly attractive to people engaging in recreation activities. They may be beaches, streamside or roadside areas, trail corridors, hunting areas of the immediate area surrounding a lake, cabin site, or campground.

Recreation Sites
Specific locations used for recreational activities such as a specific anchorage, campsite, or trail. There may be one or more recreation sites within a recreation place.

Resident Fish
Fish that are not anadromous and that reside in fresh water on a permanent basis. Resident fish in the Shamrock area include non-anadromous Dolly Varden char and cutthroat trout.

Retention Goals
Plans for maintaining unaltered habitat within a managed region (USDA Forest Service, 1984a).

Riparian Zone
Areas immediately adjacent to a body of water, the vegetation of which is usually influenced by the water.

Roaded Modified
A Recreation Opportunity Spectrum class that includes areas are less than 1/4 mile from areas of timber harvest and transportation corridors. Areas are characterized by modified natural environment where utilization practices are common and are for purposes other than recreation.

Roaded Natural
A Recreation Opportunity Spectrum class that includes areas less than 1/4 mile from roads open to public travel, major power lines, and areas of timber harvest. Areas are characterized by predominantly natural environments with moderate evidence of sights and sounds of humans.

Roads, Specified
A road including related transportation facilities and appurtenances shown on the Sale Area Map and listed in the Timber Sale Contract.

Roads, Temporary
For National Forest timber sales temporary roads are constructed to harvest timber on a one-time basis. These logging roads are not considered part of the permanent forest transportation network and have stream crossing structures removed, erosion measures put into place, and the road closed to vehicular traffic after harvest is completed.

Rotation
The planned number of years between the formation or the regeneration of a crop or stand of trees and its final cutting at a specified stage of maturity.

Rotation Age
The age of a stand when harvested at the end of a rotation.

Rural
A Recreation Opportunity Spectrum class that includes those areas with small communities, developed campgrounds, and administrative sites. These areas are characterized by substantially modified natural environments. Sights and sounds of humans are readily evident.

Sawlog (saw timber)
That portion of a tree that is suitable in size and quality for the production of dimension lumber collectively known as saw timber.

Second-Growth Forest
Even-aged stands that will grow back on a site after removal of the previous timber stand.

Sedimentation
Addition of fine organic or inorganic matter to a stream channel. Usually that portion remaining in the stream bed channel.

Semi-Primitive Motorized
A Recreation Opportunity Spectrum class that includes areas less than 1/4 mile from primitive roads, trail, or readily accessible marine travelways. Characterized by a predominantly unmodified natural environment with minimum evidence of sights and sounds of humans. Road access is not maintained in these areas.

Semi-Primitive Nonmotorized
A Recreation Opportunity Spectrum class that includes areas greater than 1/4 mile and less than 3 miles from all roads trails or readily accessible marine travelways. Provides limited opportunities for isolation from the sights and sounds of humans, a high degree of interaction with the natural environment, moderate challenge risk, and the opportunity to use outdoor skills.

Sensitivity Level
The measure of people's concern for scenic quality. In 1980 the Tongass National Forest assigned sensitivity levels to land areas viewed from boat routes and anchorages, plane routes, roads, trails, public use areas, and recreation cabins.

> ***Level 1:*** Includes all seen areas from primary travel routes, use areas, and water bodies where at least three-fourths of the forest visitors have a major concern for scenic quality.
>
> ***Level 2:*** Includes all seen areas from primary travel routes, use areas, and water bodies where at least one-fourth of the forest visitors have a major concern for scenic quality.
>
> ***Level 3:*** Includes all seen areas from secondary travel routes, use areas, and water bodies where less than one-fourth of the forest visitors have a major concern for scenic quality.

Seral-Stage
See Succession

Shade Tolerance
The relative ability of a tree to survive under the shade of adjacent trees.

Silvicultural System
A management process whereby forests are tended, harvested, and replaced resulting in a forest of distinctive form. Systems are classified according to the method of carrying out the process (see group selection, even-aged management, uneven-aged management, and clearcutting.)

Silvicultural Treatments
Forest management practices that deal with the establishment, development, reproduction, and care of forest trees.

Site
In archeology, the locus of any surviving physical evidence of past human activity, including the record of the effect of the activity on the environment.

Site Index
A measure of the relative productive capacity of an area for growing wood. Measurement of site index is based on height of the dominant trees in a stand at a given age.

Slash
Debris left after a logging operation (i.e., limbs, bark, broken pieces of logs).

Snag
A standing dead tree, often utilized by varied wildlife species as a roosting, perching, or feeding site, as well as providing potential habitat for species such as those that nest inside excavated cavities.

Species Richness
A term, or quantitative index, evaluating the diversity of species present in an area.

Stand
An aggregation of trees or other growth occupying a specific area and sufficiently uniform in composition (species), age, arrangement, and conditions as to be distinguishable from the forest or other vegetation on adjoining areas.

State Historic Preservation Officer (SHPO)
The official designated by the Governor to administer the State's historic preservation program and the duties described in 36 CFR Part 61 including nominating properties to the National Register.

Subalpine/Alpine Habitat
In Southeast Alaska, the region found on a mountain peak above 1,500-foot elevation. Vegetation is typically characterized by transitions from closed to patchy forest to open shrubs and herbaceous plants.

Subsistence Use
The customary and traditional uses by rural Alaskan residents of wild renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter or sharing, for personal or family consumption; and for customary trade.

Succession
A series of changes affecting the development of a biotic community. In forested areas, the community will pass through several vegetative stages on its path to a climax stage.

Tentatively Suitable Forest Land
Forest land that is producing or is capable of producing crops of industrial wood and (a) has not been withdrawn by Congress, the Secretary of Agriculture, or the Chief of the Forest Service; (b) existing technology and knowledge is available to ensure timber production without irreversible damage to soils productivity or watershed conditions; (c) existing technology and knowledge, as reflected in current research and experience, provides reasonable assurance that it is possible to restock adequately within 5 years after final harvest; and (d) adequate information is available to project responses to timber management activities.

Thousand Board Foot Measure
A method of timber measurement in which the unit is equivalent to 1,000 square feet of lumber one inch thick. It can be abbreviated Mbd, Mbm, or MBF.

Threatened, Endangered, and Sensitive (TES) Plants
Plant species that are considered threatened, endangered, or are sensitive to extinction. In addition to those species listed by the USFWS as Threatened, Endangered, or candidates for listing, TES species include those considered regionally rare by the Forest Service or the Alaska Natural Heritage Program.

Timber Entry
A term used to refer to how far an area is into the timber rotation based on the proportion of acreage harvested. For example, if an area is being managed for 3 entries over a 100-year rotation, the first entry would be completed when one-third (approximately 33 percent) of the available acreage is harvested (usually in 30-40 years); the second entry would be completed when two-thirds (approximately 66 percent of the available acreage is harvested (usually 60-70 years); the third entry would be completed when all of the available acreage is harvested (at the end of the rotation).

Tongass Forest Plan Revision
The re-evaluation of the Tongass Land Management Plan, most recently updated in USDA Forest Service (1991d).

Tongass Land Management Plan (TLMP)
The 10-year land allocation plan for the Tongass National Forest that directs and coordinates planning and the daily uses and activities carried out within the forest. See also Land Use Designation.

Tongass Resource Use Cooperative Survey (TRUCS)
A compilation of data on subsistence uses for evaluating the effects of the Forest Service's action contemplated in the revision of the regional Tongass Land Management Plan.

Tongass Timber Reform Act (TTRA)
An act requiring annual appropriations for timber management on the Tongass National Forest, with a provision providing for the multiple use and sustained yield of all renewable forest resources.

Understory
Any vegetation growing in a stratum definitely below the main crown canopy.

Uneven-Aged Management
The application of a combination of actions needed to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes to provide a sustained yield of forest products. Group and individual tree selection are examples of this type of management.

Unfavorable Habitat
See Habitat Suitability

Unsuitable Habitat
See Habitat Suitability

Urban
A Recreation Opportunity Spectrum class that includes areas characterized by substantially urbanized environment. The background may have elements of a natural environment. Timber harvest activities and utilization practices are common. Sights and sounds of humans predominant. Large numbers of visitors can be expected on site and in nearby areas.

Utility Pulp Volume
Logs that do not meet minimum requirements for saw timber but are suitable for the production of usable pulp chips.

V-notch
A V-shaped stream channel generally on steep mountainous terrain.

Value Comparison Unit (VCU)
Areas which generally encompass a drainage basin established in the Tongass National Forest to provide a common set of areas where resource inventories could be conducted and resource interpretations made.

Visual Absorption Capability
An estimate of the relative ability of the landscape to accept management manipulations without significantly affecting its visual character. The three VAC categories are:

> *Intermediate VAC:* Intermediate ability to accept management alternations without significantly affecting the visual character due to moderate landscape complexity.
>
> *Low VAC:* Limited ability to accept management alternations without significantly affecting the visual character due to low landscape complexity.
>
> *High VAC:* Greatest ability to accept management alternations without significantly affecting visual character due to high landscape complexity.

Visual Management Classes (VMC)
Qualitative descriptions used in project planning to indicate the relative ease or difficulty that may be required to meet the visual quality objectives for an area. VMCs include:

> *Class 1:* Management activities are not evident or are not evident to the casual observer.
>
> *Class 2:* Management activities are sometimes evident but are designed to be visually subordinate to natural landscape character.
>
> *Class 3:* Management activities are clearly evident and sometimes dominate landscape character, but are designed to appear similar to natural occurrences.
>
> *Class 4:* Management activities clearly dominate natural landscape character but are designed to appear as natural occurrences when viewed as background.

Class P: Preservation (none in the Shamrock Area)

Visual Management System
A program developed by the USDA Forest Service to identify the visual characteristics of the Forest landscape and analyze in advance the visual effects of resource management actions.

Volume
Stand volume based on standing net board feet per acre by Scribner Rule

Volume Class
Volume class strata are used to describe the average volume of timber per acre in thousands of board feet (MBF). Following are the volume class strata and the range of volume each contains.

Volume Class Strata 3: Less than 8 MBF/acre (cleared land seedlings or pole timber stands).

Volume Class Strata 4: 8 to 20 MBF/acre.

Volume Class Strata 5: 20 to 30 MBF/acre.

Volume Class Strata 6: 30 to 50 MBF/acre.

Volume Class Strata 7: 50+ MBF/acre.

Visual Quality Objectives (VQO)
Measurable standards reflecting five different degrees of landscape alteration based upon a landscape's diversity of natural features and the public's concern for high scenic quality. The five categories of VQOs are:

Preservation: Permits ecological changes only. Applies to wilderness areas and other special classified areas.

Retention: Provides for management activities that are visually evident; requires reduction of contrast through mitigation measures either during or immediately after operation.

Partial Retention: Management activities remain visually subordinate to the natural landscape. Mitigation measures should be accomplished within one year of project completion.

Modification: Management activities may visually dominate the characteristics of the landscape. However activities must borrow from naturally established form line color and texture so that its visual characteristics resemble natural occurrences within the surrounding area when viewed in the middleground distance.

Maximum Modification: Management activities may dominate the landscape. Mitigation measures should be accomplished within five years of project completion.

Glossary and Acronyms

Watershed
The drainage area of a stream.

Wetland
Those areas that are inundated by surface or groundwater frequently enough to support vegetation that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Wild and Scenic Rivers

Rivers or sections of rivers designated by congressional actions under the 1968 Wild and Scenic Rivers Act, as wild, scenic, or recreational by an act of the Legislature of the State or States through which they flow. Wild and scenic rivers may be classified and administered under one or more of the following categories:

> *Recreational river areas:* Rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.
>
> *Scenic river areas:* Rivers or sections of rivers that are free of impoundments, with watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
>
> *Wild river areas:* Rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.

Wilderness
An area established by the Federal Government and administered either by the Forest Service, National Park Service, Fish and Wildlife Service, or Bureau of Land Management in order to conserve its primeval character and influence for public enjoyment under primitive conditions in perpetuity.

Wildlife Analysis Area (WAA)
Alaska Department of Fish and Game administrative designation of the area that includes one or several Value Comparison Units (VCUs) for the purpose of regulating wildlife populations and reporting harvests.

Wildlife Habitat
The locality where a species may be found and where the essentials for its development and sustained existence are obtained.

Windthrow
The act of trees being uprooted by the wind.

List of Acronyms

ACMP	Alaska Coastal Management Program
ADF&G	Alaska Department of Fish and Game
AHMU	Aquatic Habitat Management Unit
AHRS	Alaska Heritage Resource Survey
ANCSA	Alaska Native Claims Settlement Act of 1971
ANHP	Alaska Natural Heritage Program
ANILCA	Alaska National Interest Lands Conservation Act of 1980
BMP	Best Management Practice
CFL	Commercial Forest Land
CFR	Code of Federal Regulations
CMT	Culturally Modified Tree
CZMA	Coastal Zone Management Act of 1976
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EVC	Existing Visual Condition
FEIS	Final Environmental Impact Statement
FICWD	Federal Interagency Committee for Wetland Delineation
FPA	Forest Practices Act
FSH	Forest Service Handbook
FSM	Forest Service Manual
GIS	Geographic Information System
GMU	Game Management Unit
GNP	Gross National Product
HCA	Habitat Conservation Area
HSI	Habitat Suitability Index

IDT	Interdisciplinary Team
KV	Knutsen-Vandenberg Act
LTF	Log Transfer Facility
LUD	Land Use Designation
LWD	Large Woody Debris
MBF	One thousand board feet
MIS	Management Indicator Species
MMBF	One million board feet
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act of 1969 (as amended)
NFMA	National Forest Management Act of 1976
NMFS	Nation Marine Fisheries Service
OHV	Off Highway Vehicle
OTA	Office of Technology Assessment
RM	Roaded Modified
RMO	Road Management Objective
RN	Roaded Natural
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
SHPO	State Historic Preservation Officer
SP	Semi-Primitive Land Use Designation
SPM	Semi-Primitive Motorized
SPNM	Semi-Primitive Non-Motorized
TES	Threatened, Endangered, and Sensitive
TLMP	Tongass Land Management Plan of 1979 (amended in 1985)
TRUCS	Tongass Resource Use Cooperative Survey
TSP	Total Suspended Particulate Matter
TTRA	Tongass Timber Reform Act
USACOE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
VAC	Visual Absorption Capability
VCU	Value Comparison Unit
VMC	Visual Management Classes
VMS	Visual Management System
VMT	Vehicle Mile Traveled
VQO	Visual Quality Objective
WAA	Wildlife Analysis Area

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